A GAMIFIED E-LEARNING WEB APPLICATION WITH AI-DRIVEN STUDY PLANNER UTILIZING LLAMA

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Software Engineering with Honours

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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ABSTRACT

E-learning has transformed the way of traditional learning by making learning accessible for students anywhere and anytime with technology devices. Thus, the project focuses on developing a gamified e-learning web application powered by artificial intelligence (AI) using Large Language Models (LLMs) integrated with LangChain for secondary school students to improve the learning experience. The web application is built using the Model-View-Controller (MVC) architecture, with Laravel for the backend and React for the front end. The three user modules, students, teachers, and administrators, are included to provide role-specific functionalities. Students can enroll in courses, access learning materials, engage in gamified challenges, track their learning progress, and participate in discussion forums. They also benefit from personalized AI-generated study plan timetables that analyze their strengths and weaknesses across subjects. Experimental results show that LLaMA 3.1 achieves higher accuracy and stability than Qwen 2.5, making it a stronger candidate for AI-driven study planning. Teachers are able to manage course content, monitor student performance, provide feedback, and interact with students, while administrators oversee user management, platform usage, and gamification elements. By combining gamification with AI-driven personalization, the web application aims to motivate students for more engagement to improve learning retention.

Keywords: Artificial Intelligence, E-Learning, Gamification, Large Language Models (LLMs), LLaMA, Personalized Learning

Subject Area: AZ191-193 Evaluation, LB1603-1696.6 Secondary education. High schools, T61-173 Technical education. Technical schools

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LIST OF SYMBOLS / ABBREVIATIONS

AI	Artificial Intelligence
LLMs	Large Language Models
LMS	Learning Management System
ML	Machine Learning
MVC	Model-View-Controller
NLP	Natural Language Processing
WBS	Work Breakdown Structure

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CHAPTER 1

INTRODUCTION

1.1   General Introduction

In this modern era, the traditional learning approach has become less effective for students to stay engaged and motivated in class. The traditional methods fail to get the attention of students, especially in secondary education. Many secondary students highly rely on textbooks, one-way teaching, and standardized testing, and these lead to disengagement, especially for Gen Z students who are used to interactive and fast-paced digital content. Thus, there is a growing need can be seen for more interactive and personalized learning experiences. In this case, the proposed project is introduced by focusing on the development of a gamified e-learning web application with an AI-driven study planner utilizing LLaMA to make the learning process more fun, personal, and effective for students.

1.2   Importance of the Study

Sustainable Development Goal (SDG) 4 focuses on the quality of education and this directly supports the gamified e-learning web application. This is because the goal is to provide opportunities for lifelong learning so that everyone has access to high-quality and inclusive education based on their own needs (United Nations, 2024). The gamified e-learning platform is designed and developed to increase learners' motivation and engagement especially learners who are struggling with traditional learning methods through the integration of gamification elements like points, rewards, badges, and daily challenges. Besides, the implementation of personalized AI-generated study plans can further provide customized learning to accommodate a wider range of learners through analysis of their strengths and weaknesses. These approaches achieve success in education and also promote equal access to education regardless of socio-economic background, which is aligned with the vision of SDG 4. As a result, this project can contribute to building an effective educational ecosystem where everyone can feel included and motivated through learning at their own pace.

1.3   Problem Statement

1.3.1   Limited Gamification in E-Learning

Most e-learning platforms focus on course and content delivery with very little or no gamified elements. In fact, these features are actually important in driving extrinsic motivation by making learners feel more rewarded and competitive in learning. Learners may find it difficult to stay motivated or measure their achievement without these gamification elements and features which can lead to loss of interest and lower participation rates. Therefore the proposed project will incorporate with gamification elements like points, rewards, badges, and the progress bar to create a sense of achievement and competition among learners.

1.3.2   Absence of AI-Powered Personalized Study Plan Timetables

An effective e-learning platform should provide personalized study plans to each learner by adjusting to their learning styles, behaviours, strengths, and weaknesses. However, the existing e-learning platforms only generally offer basic functions and approaches to learning materials. Without customization and personalization, learners could find it difficult to maintain consistent progress. This is due to the lack of structure and planning in study which will make it harder to build productive study habits and stay motivated at all times. As a result, learners can feel overburdened and this can lead to an ineffective learning process. Thus, an AI-generated personalized study plan timetable is believed to improve the learning experience by adapting to the individual needs of each learner. Thus, this feature is proposed to generate individualized study plan timetables for learners to develop productive study routines.

1.3.3   Difficulty in Tracking by Traditional Learning Methods

The traditional learning methods have no effective tools for both learners and instructors in tracking progress. It relies more on static content such as text-based learning lessons, physical assessments, and pre-recorded videos. These traditional methods do not provide real-time insights about how well learners have applied the knowledge gained. Without built-in progress tracking, learners are not able to assess their understanding and identify areas of weakness for

improvement. In this case, a customized progress dashboard can be developed to allow learners to monitor their progress easily. Besides, the web application can provide history tracking for learners to review past activities and accomplishments in each course. This makes the learning process more transparent through the structured learning approach by utilizing tracking features.

1.3.4 Limited Social Interaction, Peer Collaboration, and Immediate Feedback

An e-learning environment should be built to promote interaction through collaborative learning and immediate feedback. This is to make sure that all learners feel connected and supported. However, the existing e-learning platforms give learners fewer opportunities to interact after class. As a result, learners often go through lessons without having the chance to discuss topics to share ideas or work together with peers. The opportunities for deeper understanding through discussion are eliminated due to the absence of peer support and group-based learning. It is harder for learners to correct mistakes and clarify problems faced without immediate feedback and responses. This can lead to isolation and feelings of disconnection hence reducing motivation to study. Thus, the gamified e-learning platform is proposed to integrate communication tools like discussion forums and instant feedback to provide continuous support for the learners.

1.4 Objectives

- To develop a gamified e-learning web application with an AI-driven study planner for secondary students.
- To evaluate and compare the accuracy of performance of LLaMA 3.1 and Qwen 2.5 for study plan timetable generation using the Weighted Scoring Model.
- To assess the usability and effectiveness of the web application in supporting effective learning, progress tracking, and student-teacher engagement using the System Usability Scale (SUS).

1.5   Project Solution
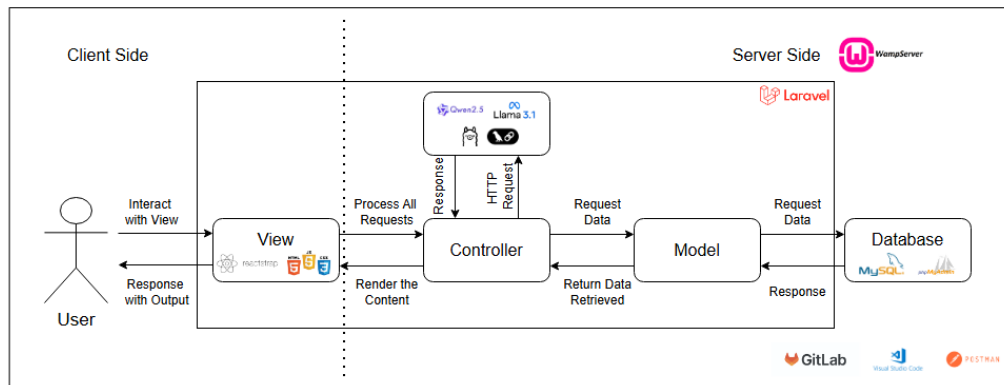
Figure 1.1: Model-View-Controller (MVC) Architecture.

The Model-View-Controller (MVC) architecture is proposed for the gamified e-learning web application due to its scalability and ease of maintenance. This is because there are three separated components where the model handles all data, the view displays content, and the controller manages the user's interaction and links the model to the view.

In this case, Laravel will be used as the backend framework as it follows the proposed development architecture. For the front end development, React is selected together with ReactStrap. For the AI-powered personalized study plan timetable, the LangChain framework with both Llama and Qwen models can be integrated into the backend by utilizing the controller logic to communicate with the AI model to generate a customized study plan timetable. The Postman will be used to test the APIs during backend development to ensure seamless integration with the frontend. Overall, for the server side, the backend will be hosted on WampServer while the MySQL with phpMyAdmin for storing and managing all data. At the same time, the project is stored and managed in GitLab for better version control.

In conclusion, the above proposed solution is able to enhance the development process by allowing the web application to be easily modified in the future without affecting other core functionalities. This makes the overall project more manageable in the long term and ensures it can be developed and delivered within the timeline.

1.6   Project Approach
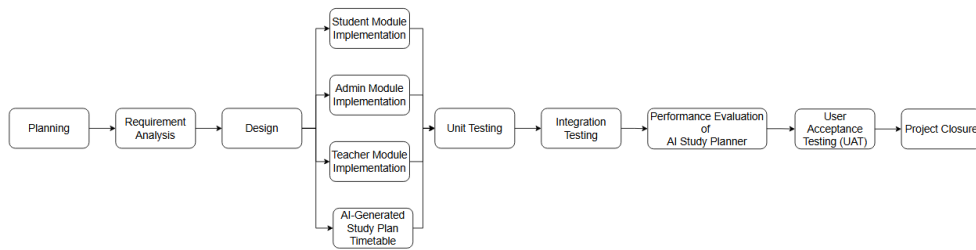
Figure 1.2: Parallel Software Development Process for Gamified E-Learning Web Application.

The parallel software development process is followed by this project as this approach can speed up the development time since there is only 14 weeks are allocated for development. This is because it allows switching through the three different modules to build core functionalities so that the dependency can be reduced. For this web application that includes an AI-powered study plan timetable and personalized dashboard for each type of user role, developing these separately and then integrating them later can make the whole process much more efficient. Additionally, the parallel software development methodology also supports modular development which is aligned with the MVC architecture used in this project. Since each of the modules was developed and tested separately before system integration, any risks and bugs can be identified and fixed earlier to ensure that the project can be delivered on time at the highest quality.

1.7   Project Scope

1.7.1   Target Users

The primary target users of this gamified e-learning web-based application are secondary school students who engage with the platform for learning, while the teachers and administrators serve as secondary users in managing the platform.

1.7.2 All Modules

1.7.2.1 Profile and Account Management

All users can log in using their registered email and password. Students can register for an account, while admins can create accounts for teachers. They can view and update their personal information when needed. For teachers, they are required to submit the required documentation for verification purposes in order to access teaching functionalities.

1.7.2.2 Dashboard and Analytics

All users have their personalized dashboard. For students, they can track their progress, course completion status, and learning history. For teachers, they can view insights for the course performance, student engagement levels, and current submissions. The admins are provided with system analytics which include platform usage statistics, audit logs, and user activity to better monitor the system.

1.7.2.3 Notifications

All users can receive real-time notifications about important updates. For students, the notifications can include course announcements, upcoming deadlines, and feedback received from teachers. While for teachers, they are notified of student submissions and inquiries. Additionally, the admins are alerted to system updates, user activity, and submissions of support tickets.

1.7.2.4 Calendar and Deadline Tracking

All users can access the calendar to view deadlines and important events for the course. The students and teachers are able to track the due dates for quizzes and assignments for the courses enrolled in or assigned to. Meanwhile, for the admin, can view the due date for quizzes and assignment for all courses. This is to ensure all users are stay informed of upcoming tasks.

1.7.3 Student Module

1.7.3.1 Course Management, Assessment, and Performance Tracking

Students can view a list of courses and enroll in courses to access all learning materials associated with the courses chosen. The students can then view the

course announcements updated by teachers in each course. They can also participate in quizzes and assignments created by teachers with deadlines displayed in the calendar. In this case, students' progress, course completion, and history which include the attempted quizzes and assignments along with the feedback given, can also be tracked for each course.

1.7.3.2 Gamification and Motivation

The students are able to earn points, rewards, and coins by attempting quizzes and submitting assignments. They can also collect badges, climb leaderboards, and complete daily missions or challenges throughout the learning process. All these gamification elements aim to increase student engagement and motivation by making learning more interactive and rewarding.

1.7.3.3 Communication and Interaction

After attempting and submitting the quizzes and assignments, the students can receive personalized feedback from teachers for improvement. Besides, they are encouraged to build a supportive learning community. They are allowed to participate in discussion forums for the courses they are enrolled in. This provides students with a space for open discussions to exchange ideas and ask questions between teachers and peers.

1.7.3.4 AI-Powered Personalized Learning

The students can generate personalized study plan timetables based on their strengths and weaknesses in each subject which are aligned with their school schedules. They can also create their own to-do lists to have a clear overview of daily and weekly goals to be achieved.

1.7.4 Admin Module

1.7.4.1 User Account and Role Management

There is a list of users that can be filtered by roles to have quick access. Admins can manage user accounts by updating their personal information or deleting their accounts. They can also verify teacher credentials to make sure that only qualified teachers are granted access to teaching functionalities.

1.7.4.2   Course and Content Moderation

The admins need to manage the structure and quality of courses and learning materials. They have the authority to perform actions like adding, editing, and deleting the course content and materials to ensure consistency. Besides, the admins can also assign or unassign users to and from a specific course.

1.7.4.3   System Support and Gamification Configuration

The admins are responsible for managing user inquiries or support tickets to resolve issues that students and teachers can submit when they need assistance. They also maintain consistency in the gamification system by handling the daily or weekly missions, badges, and leaderboard settings.

1.7.5   Teacher Module

1.7.5.1   Course Management

Each of the teacher is assigned to courses and they can post announcements, upload course materials, and create quizzes and assignment questions by setting deadlines, associated points and rewards. They can also edit, update, and delete course information when necessary.

1.7.5.2   Teacher-Student Interaction and Engagement

The teachers can view a list of students enrolled in their course. This is for them to track students' performance by looking at the attempted quizzes and assignments to provide personalized feedback to students based on the results obtained. For further communication and interaction, they can also create and participate in discussion forums to solve student queries by replying publicly.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

This chapter explores the aspects of e-learning, gamification, personalized learning, web development frameworks, and software development methodologies to build a strong foundation for the gamified e-learning web application. The review of e-learning starts with the definition of e-learning, its role in secondary education, and the different learning approaches, synchronous and asynchronous, together with the technologies associated. The review of gamification then discusses how game-like elements increase learners engagement and motivation during learning. The chapter also looks at personalized learning, focusing on AI-powered study plans, the role of large language models in education, and how frameworks like LangChain integrate Llama to generate study plan timetables (Auffarth, 2023). Besides, there is a comparison of AI-powered study plan approaches for criteria like customization, control, security, data privacy, cost, and deployment flexibility. Other than that, the review of web development frameworks also compares the popular backend and frontend frameworks to determine the best fit for this project. The chapter also analyzes existing e-learning platforms to identify strengths and weaknesses before concluding with a discussion on software development methodologies to ensure a structured approach to develop the e-learning platform.

2.2   Review of E-Learning

2.2.1   Definition of E-Learning

E-learning is also known as electronic learning, refers to using different electronic devices, including mobile phones, tablets, laptops, etc., to access educational content via the Internet (Dhawan, 2020). Besides, Rawashdeh et al. (2021) described e-learning as delivering educational programs to distant or remote learners and allowing them to learn outside of the traditional classroom. The e-learning approach aims to make education more accessible to broader learners. Similarly, Choudhury and Pattnaik (2020) defined e-learning as a way of gaining knowledge and skills through well-designed course content that

meets recognized standards, delivered via electronic platforms like the Internet, advanced Web 4.0 technology, intranets, and extranets. Additionally, Amiti (2020) further emphasized that e-learning is a process that occurs in a virtual classroom where teachers and students collaborate. The teacher serves as the instructor who tries various strategies to deliver effective instruction, while students, as the learners, actively participate in receiving and processing information obtained as much as possible to get a picture of daily lessons.

2.2.2 E-Learning in Secondary Education

In secondary institutions, e-learning has changed the way of learning by making education more accessible, affordable, and flexible. Unlike traditional learning in the classroom as e-learning allows learners to study anytime and anywhere using technology. It is important because it reduces costs for both learners and educational institutions since it does not require classrooms, physical learning materials, and the need for travel (Jacksi et al., 2021). The learners can access quality education without spending extra money on transportation and learning materials as long as they have an internet connection.

The impact of e-learning becomes more significant especially during the pandemic of COVID-19, prompting a study to explore how they adapted to the new learning mode. There is a research conducted among one hundred secondary school learners from three high schools in Delhi. According to a study by Priyadarshini and Bhaumik (2020), 33.8% of learners agreed that they could study effectively by their own without assistance from instructors. Other than that, Priyadarshini and Bhaumik (2020) also found that 45.9% of learners desired to continue with e-learning as they enjoyed the freedom and flexibility of studying at their own pace while 52.7% of learners reported they felt more comfortable taking online exams after getting used to digital learning at the same time. Other than that, learners suggested using a single application by all instructors for online teaching and focusing on e-learning platforms like Google Classroom or any learning management system (LMS) for organizing learning resources and better monitoring learners' performance. Other key concerns include the need for proper teacher training and the need for improved teaching methodologies for e-learning. The results show that although e-learning offers many advantages, it also comes with challenges as part of the learners appreciate

flexibility while some of them still need guidance and support from instructors to learn effectively.

There is another study that was conducted among 135 learners and 20 instructors to assess the advantages and disadvantages of e-learning implementation during the COVID-19 pandemic. In the Maatuk et al. (2021) study, 119 learners agreed that e-learning helped improve their educational level, while 17 instructors believed it enhanced learners' technological skills. The transition from traditional learning methods to e-learning encourages learners to use technology and social media platforms, equipping them with a variety of technological skills that can be applied in the future (Basar et al., 2021).

However, not all aspects of e-learning were positive. Both learners and instructors were least likely to agree that e-learning reduces misunderstandings, as the learning process becomes more of a digital conversation rather than a traditional face-to-face communication and interaction. This was reflected in the study by Maatuk et al. (2021) where only 5.8% of learners and 68.2% of instructors appreciated how well it minimized misunderstandings during e-learning. Besides, Maatuk et al. (2021) found that 107 learners reported that e-learning increased their academic burden as the workload shifted from faculty to them which required them to take responsibility for their own education. Meanwhile, 16 instructors noted that e-learning required more financial resources than traditional education (Maatuk et al., 2021). Additionally, the instructors found online teaching challenging due to the need for reliable advanced technology tools, high-performance computers or laptops, and stable internet connections. Especially for some senior instructors with a lack of technological knowledge who struggled with using these, making online teaching less efficient and increasing the financial burden of investing in digital equipment (Lukas and Yunus, 2025).

Google Classroom is one e-learning platform that has been widely used in secondary education by both learners and instructors for the learning and teaching process. Kwame Ansong-Gyimah (2020) found that learners are more likely to continue using Google Classroom if they find it useful and easy to navigate. Since the majority of today's secondary education learners are from Generation Z and the early part of Generation Alpha, there has been a major

change in how they view and use ICTs, making them more open to using e-learning platforms.

2.2.3   Synchronous and Asynchronous E-Learning Approaches

E-learning is divided into three categories that include synchronous, asynchronous, and hybrid mode which is a combination of the two. Many educational institutions adopt these approaches to maximize the effectiveness of online learning. The synchronous e-learning, according to Amiti (2020), is the real-time interaction whereby learners and instructors meet simultaneously on an online platform that mirrors the structure of a traditional classroom, while asynchronous e-learning is an unsynchronized approach whereby learners and instructors participate at different times. Thus, the hybrid method combines synchronous and asynchronous e-learning to provide a balanced approach by bringing together live interaction with self-paced and flexible learning.

The synchronous e-learning environment is one where learners and instructors conduct the learning and teaching sessions on a designated online platform for communication and discussion (Zydney et al., 2020). As Amiti (2020) stated, the synchronous e-learning approach is able to gather learners from different locations together, and thus benefiting introverted learners who may struggle in traditional classrooms by reducing stress and allowing them to learn in a familiar setting. A synchronous e-learning session typically starts with an online video conference by gathering learners and instructors with their cameras on for real-time interaction. Thus, this approach is highly collaborative by allowing learners to ask questions, receive immediate answers, and gain real-time feedback since the learning session is conducted on a virtual platform to facilitate interactive learning sessions (Fernandez, Ramesh and Manivannan, 2022). However, Amiti (2020) also noted that it becomes difficult to schedule a class with this approach as it is not easy to conduct it with the entire class if the instructor needs to synchronize real-time interaction or one-to-one. Additionally, if a learner's listening skills are poorer than other classmates in the class, the instructor may need to slow down when speaking during the teaching session. However, this adjustment may not be well-received by more advanced learners. If the arrangement and division of learners' levels are not precise, those lower-level learners may need extra help outside of the classroom.

Even though synchronous e-learning has many advantages, requiring everyone to be online at the same time can be limiting. That is why asynchronous e-learning comes in by creating an environment that allows learners and instructors to participate in teaching and learning sessions at different times through a designated online platform (Fernandez, Ramesh and Manivannan, 2022). The independent e-learning approach ensures that all learning materials including handouts, PowerPoint presentations, articles, and pre-recorded video lectures are readily available on the online learning platform. This flexible approach enables learners to access materials, participate in discussions, and complete assignments anytime at their own pace without the need for real-time interaction since it is a self-guided learning approach (Fadhilah et al., 2021). For example, the learners can access all learning materials to study and complete the assignment at their own pace before submitting it via an online learning platform. However, Amiti (2020) emphasized that a timeframe should be established to ensure learners complete their assignments within a set deadline. The challenge faced by implementing asynchronous e-learning is that learners may forget to complete the assigned asynchronous tasks due to a lack of motivation. Fernandez, Ramesh and Manivannan (2022) highlighted that this is due to the lack of direct interaction with instructors which can lead to feelings of isolation as lesser conversation reduces the sense of connection, hence causing procrastination in their assigned tasks due to minimal supervision.

2.2.4   Technologies Used in E-Learning

E-learning relies on various technologies to deliver high-quality and effective teaching and learning processes. The following technologies facilitate knowledge sharing, and information exchange, and enhance communication and interaction between learners and instructors during online learning.

2.2.4.1 Learning Management System (LMS)

The most frequently used learning management system is the Learn-On-Line (LOL) Learning Management System, which is an application that supports online learning and operates as a web application (Xin et al 2021). There are various types of LMS systems that exist on the market and are often used for

education purposes which include cloud, self-hosted, open-source, mobile, corporate, and educational (SAP, 2024). Thus, LMS can be interpreted as the backbone of e-learning platforms to connect both learners and instructors by managing course contents, accessing learning materials in different formats, tracking learning progress, and supporting quizzes, exercises, and assignments.

Additionally, the LMS platforms support both synchronous and asynchronous learning processes. For real-time interaction, features such as live chat, video, and online conferencing are offered for synchronous delivery, while community spaces, discussion forums, instant messaging, and self-assessment tools for asynchronous delivery (Bradley, 2021). It combines interactive elements such as text, video, and audio to increase learners' interest in learning.

Another technological advantage is that LMS platforms can be accessed by using different platforms. It is able to help reduce the expenses associated with physical learning materials by allowing learners to access them across different devices at any time and from any location with cloud-based LMS solutions. However, some LMS platforms such as Google Classroom have rigid structures that may not be appropriate for all learners from different groups. This is due to certain LMS solutions providing a lack of customization options, restricting the adaptability of educational institutions with special requirements.

2.2.4.2 Communication Tools

According to Ouariach (2023), everything from platforms and software to applications that enable individuals to connect, collaborate, share, and exchange information regardless of time or place are referred to as online communication tools. These tools are important in online learning so that both instructors and learners can communicate effectively.

When it comes to synchronous online communication tools, Zoom and Microsoft Teams are the most popular and often used platforms because of their features for live video conferencing and instant messaging in online learning. These tools allow audio and video transmission over the internet with very little latency and so are ideal for online learning. According to Hargreaves et al. (2022), they further integrated AI in the form of virtual backgrounds where meetings can be held in a virtual classroom to make online meetings feel more like a familiar environment. Other than speech-to-text transcription and real-

time language translation, Microsoft Teams also integrates AI-powered note-taking that automatically summarizes the main ideas from online meetings or discussions. This could help learners review lessons more efficiently if they could not catch up during the lessons.

While for asynchronous online communication tools, online discussion forums, and emails allow learners to communicate among themselves or with the instructors at their own pace during learning. For example, Moodle allows the user to ask questions in the discussion posts and receive answers which are then stored in a SQL database together with the discussion posts that were made using PHP and JavaScript.

2.2.4.3 Assessment and Feedback Tools

With the growth of technology, instructors can design and create exams and quizzes with multiple-choice, open-ended, and true/false questions using free online assessment platforms like Google Forms and Kahoot!. This approach is practical and efficient in evaluating learners' performance during the COVID-19 pandemic. According to a study by Yeni Hadianti et al. (2021), 60% of instructors agreed that they may use Google Forms to create online tests relevant to their subjects, and learners also find it to be a useful tool for assessments during online learning. Besides, the findings of Yeni Hadianti et al (2021) also indicated that Google Forms could serve as an effective assessment method for online learning since the results demonstrate that learners' average scores improved across all subjects.

Nevertheless, both platforms that offer similar features enable automated grading which helps reduce the time required for manual correction to ensure consistent evaluation. The real-time feedback mechanism provides instant feedback so that learners can get immediate responses after attempting the question to help them identify mistakes and correct misconceptions immediately. Additionally, for instructors, they can receive built-in response analysis which is integrated with Google Sheets for better tracking of learners' performance. This can minimize instructors' workload and allow them to have more time so that they are able to focus on teaching and learner engagement during online learning.

2.2.4.4 Artificial Intelligence (AI)

According to Gligorea et al. (2023), artificial intelligence (AI) is defined as the creation of intelligent machines that is able to mimic human intelligence in order to carry out tasks like perception, thinking, and decision-making. In the context of e-learning, AI is important in personalized online learning experiences using the data collected from LMS and assessments to have a deep analysis. According to Arun Kumar et al. (2022), using AI technology in any learning system makes it possible to determine learners' strengths, weaknesses, and preferred learning methods so that real-time feedback can be given to adjust difficulty levels in improving learners' academic performance. Besides, AI can also be applied by integrating machine learning (ML) algorithms to monitor learners' learning behaviors. This can be useful for developing customized personal learning systems for each of them based on individual performance. In this case, the recommendation systems using AI can provide personalized learning materials such as articles and videos based on individual learner needs.

Since the demand for technologies grow rapidly among learners, the AI-powered chatbots using natural language processing (NLP) and ML are being introduced to provide instant and immediate support to learners as smart teaching assistants to benefit learning outcomes (Chang et al., 2023). This is because an AI chatbot can perform tasks like answering student questions and providing tutor sessions with step-by-step explanations of processes by analyzing previous conversations before responding. An instructor can also use AI chatbots for automating feedback or other follow-up tasks. However, the overuse of AI technology can reduce the thinking abilities of the learner. Rather than limiting the use of AI chatbots in learning, instructors may inform the students and offer guidance on the ethical and effective uses of AI.

2.3 Review of Gamification

2.3.1 Definition and Concept of Gamification in Secondary Education

Education at all levels, from primary and secondary schools to universities can benefit from gamification. There are several ways to define gamification. According to Christopoulos and Mystakidis (2023), gamification involves applying game design elements and principles to non-gaming environments, a definition that is most frequently cited and commonly used in academic

discussions. Sanchez et al. (2020) then described gamification as converting a nongame context into a game-like activity by applying game principles and utilizing game components such as badges, points, bonuses, and leaderboards. Meanwhile, Vrcelj et al. (2023) stated that gamification is able to engage learners and encourages learning and problem-solving through mechanics, aesthetics, and player-perspective thinking.

Gamification is different from game-based learning. Gamification in education can be known as the addition of game-like elements to a non-game educational environment to enhance learner participation while game-based learning can be seen as a learning approach where the entire lesson or concept is conducted through a game (Karagiorgas and Niemann, 2017). In other words, gamification utilizes elements like rankings, rewards, and challenges in existing educational content for learning, while game-based learning uses actual games as the main teaching medium by guiding learners through gameplay.

Besides, the most common gamification components used in secondary education are challenges, badges, leaderboards, progress bars, and points and rewards. One example of widely used gamification e-learning platform in secondary education is Kahoot! where instructors are able to create interactive game-based quizzes. According to the study done by Vrcelj et al. (2023), cooperating all these gamification components in secondary education can positively impact learning activities by increasing learners' motivation and achievement of learning outcomes. This also allows learners to track their progress in order to identify areas of improvement through gamification elements like immediate feedback and a progress bar (UOW Malaysia, 2022). Besides, the study also showed that gamification methods such as collaborative learning and discussion forums are able to improve communication among learners, promote critical thinking and problem-solving skills, and thus encourage active learning (Vrcelj et al., 2023). However, competition through leaderboards can also cause stress to learners who continuously perform worse at the same time. Additionally, UOW Malaysia (2022) mentioned unlimited attempts and trying to encourage students to try learning activities again without feeling guilty about their failures. Thus, in the context of gamification in e-learning, learners in secondary education must view challenges as opportunities for continuous improvement rather than obstacles in order to benefit from them.

2.3.2   Theories of Gamification in E-Learning

In the e-learning context, gamification positively affects learners since it is possible to enhance their engagement, motivation, and knowledge through the integration of gamification elements such as points, badges, leaderboards, achievements, progression levels, rewards, and interactive challenges into learning. However, according to Sailer and Homner (2019), simply adding game elements does not guarantee effective learning as the concept must be aligned with psychological theories that explain intrinsic and extrinsic motivation. These theories are self-determination theory (SDT), behaviorism, and reinforcement theory.

The shift from physical learning to online learning during the COVID-19 pandemic has caused difficulties for both learners and instructors. Instructors who lack online teaching experience and learners who fail to get direct help from e-learning may experience stress and anxiety which can then lead to various mental health concerns (Chiu, 2021). According to SDT, it is believed that three intrinsic fundamental psychological needs where autonomy, competence, and relatedness play an important role in driving motivation in e-learning (Shah et al., 2021). Learners are more likely to stay engaged and motivated when these needs are met. Thus, learners should have a sense of control over their studies based on the three perspectives.

The first principle is autonomy where learners can decide their learning path and progress it at their own pace. This can be done by giving them the chance to choose difficulty levels and modules and set personal goals to reduce pressure and increase intrinsic motivation. Besides, competence is promoted when learners receive immediate feedback on quizzes, earn points and rewards, and receive digital badges that are able to help them develop new skills and build confidence through the learning journey. Shah et al.(2022) also mentioned that all these elements provide a clear indicator of achievement for learners and help them recognize their progress so that they can feel a sense of mastery over each of the subjects. Besidely, relatedness ensures that learners feel a sense of belonging and social connection through collaborative activities from discussion forums and interactive gamification elements like leaderboards to reduce isolation and enhance participation in online learning environments (Li et al., 2024). This is because these elements are able to create a sense of

community among learners. According to Chiu (2021), introducing a gamification e-learning platform without taking the three principles into consideration can be a risk as motivation cannot be guaranteed by simply adding gamification elements like points and leaderboards. However, gamification elements are able to create engaging, rewarding, and socially connected learning experiences for learners when it is designed with SDT.

According to Nurfadillah et al. (2024), the behaviorism and reinforcement theory focuses on how learning behaviors can be shaped through both positive and negative reinforcements, and it is believed that one is considered to have learned something if he can demonstrate behavioral changes. This theory suggests that the behaviors from positive consequences are more likely to be repeated while those from negative consequences are less likely to be repeated, making it an important indicator to see learners' learning outcomes (Nurfadillah et al., 2024). For positive reinforcement, when learners receive recognition such as points, badges, and virtual prizes when completing a task and unlocking new levels, can encourage them to engage in desired learning behaviors and thus they are more likely to repeat it in the future. This is because all the rewards can reinforce learners' continuous participation and drive motivation in learning. Meanwhile, for negative reinforcement, removing an undesirable condition in learning can encourage learning behaviors. For example, the learners can be motivated by removing obstacles or penalties such as skipping repetitive exercises after mastery. Same thing goes to the adaptive learning system which can reduce the number of practice questions for learners who consistently perform well to remove burdens and redundant tasks to ensure that learners stay motivated and focus more on progress. By applying behaviorism and reinforcement theory in gamified e-learning environments, an adaptive learning experience can be created that not only enhances motivation but also supports both long-term knowledge retention and skill development.

2.3.3   Gamification Elements in Learning

Integrating gamification elements into learning is no longer a teacher-centered process but a student-centered process. According to Sailer and Homner (2019), game-like elements in non-gaming contexts, such as education, are able to enhance engagement and motivate learners to stay active while learning, and

thus it is undeniable that it has a positive impact on learners' achievement. Abdul Rahman et al. (2018) mentioned that the common gamification elements and the impacts are as follows, listed in descending order of application in learning:

Table 2.1:   Impact on Learning for Each Gamification Element.

Gamification Elements	Impact on Learning
Points and Rewards	It increases learners' motivation and engagement in e-learning.
Leaderboard	The ranking can encourage competition but also create pressure for some learners.
Digital Badge	The badges offered can act as tangible rewards to recognize achievements and skills mastered by an individual.
Challenge	The difficulties faced can promote critical thinking and problem-solving to come out with solutions to overcome obstacles.
Feedback	The personalized feedback helps identify strengths and areas for improvement.
Collaboration	Collaboration among learners encourages teamwork and allows knowledge-sharing to improve communication and social learning skills.
Exploration	Curiosity and deeper learning by discovering content at own speed is encouraged to promote independent thinking.
Storytelling	A narrative-driven experience can be built and let the learner to immersed in learning to enhance engagement.
Experience System	The learners' progress can be tracked easily through levels and creating a sense of progression and long-term motivation.

From the study, a conclusion can be drawn that the four gamification elements, where points and rewards, leaderboards, digital badge, and challenges are important for a successful gamification learning activity. These elements are interconnected and often used together for a learning activity. When combined, these gamification elements are able to create an interactive and dynamic learning environment.

Points and rewards are the most applied gamification elements in learning due to their direct impact on motivation and engagement. It can be seen that points and rewards are always incorporated into the leaderboard to display rankings and points (Abdul Rahman et al., 2018). Additionally, most of the games with goals are always associated with points and rewards in promoting continuous motivation for learners. This is because a game typically has winners and losers, thus making the points and rewards an essential element in creating competition between players for determining success.

The leaderboards are used to display learners' latest ranking to promote competition among them. Abdul Rahman et al. (2018) also stated that this approach is suitable for learners from the current generation who enjoy sharing their achievements through showing their progress to the public. The points and ranks show how learners perform and motivate the learners at the top to maintain their position while encouraging those with lower ranks to improve in order to catch up (Li et al., 2024). However, it can also have a negative impact on learners who consistently rank at the bottom by decreasing their motivation.

Unlike leaderboards which emphasize competition, the digital badge focuses on individual accomplishments which serve as a form of recognition and achievement in gamified learning activities to allow learners to earn rewards for completing tasks or reaching milestones (Fanfarelli, 2019). According to Cheng et al. (2019), digital badges can be an attractive reward in facilitating learners' goal setting when they come with a unique shape and make learners feel worthy of collecting them as their personal collection. This is aligned with the human tendency to collect valuable or exclusive items. In this case, indirect competitions are created among learners if the digital badges can be viewed by other learners to display achievements and increase motivation in the learning process. For the next gamification element, the challenge is also applied in the gamified learning activities. However, it has a dual effect on learners. If a

challenge is too difficult, learners may reduce motivation and give up during learning, but if there is no challenge, the game will feel boring (Abdul Rahman et al., 2018). Thus, it is vital to strike a balance to maintain learning interests while ensuring a sense of accomplishment.

2.4 Review of Personalized Learning

2.4.1 Study Plan Timetable for Personalized Learning

According to Akyuz (2020), personalized learning is an educational approach that makes education more interesting by adjusting instruction and learning experiences to each learner's unique needs, strengths, and learning preferences. Different learners may have different ways to learn as long as it is able to achieve the learning outcomes (Ingkavara et al., 2022). By focusing on individual needs, learners are able to learn differently by exploring learning materials that they are interested in and learning at their own pace. This is aligned with the study plan timetable, which helps users structure their study schedules dynamically based on their academic performance rather than following a rigid timetable.

A study plan timetable is a time-management plan used to plan study time by allocating time for different subjects to achieve academic goals. According to Gogoi (2019), a study plan timetable helps to improve time management by allocating specific time slots to study all subjects to ensure that all topics are covered. Additionally, a well-planned study plan will include unpredictability by allowing learners to adapt to unexpected situations without feeling overwhelmed. This adaptability is able to help reduce stress and anxiety since the learner has followed the plan and is well-prepared for an exam (Gogoi, 2019). By studying earlier, learners can memorize more effectively and obtain better scores during exams. Especially in today's era of advanced technology, an AI-powered study plan timetable using a large language model can further benefit learners as it is able to analyze learners' available time and optimize self-learning sessions for them by balancing study time to all subjects for efficient learning.

2.4.2   Large Language Models (LLMs) in Education

Kasneci et al. (2023) described Large Language Models (LLMs) as artificial intelligence models that are trained on huge databases of text content and are able to generate human-like texts, respond to questions, and perform other language tasks with high accuracy. They use deep learning techniques like transformer architecture to process and analyze language patterns. Examples such as the GPT series, Bard, Gemma, Llama, and Qwen are widely used across various industries, including education.

The large language models play an important role in personalized learning environments by improving learning experiences based on learners needs. The first example can be seen when AI chatbots and virtual assistants like ChatGPT are used to provide instant feedback and tutoring to help learners by explaining concepts to answer questions. According to Kasneci et al. (2023), it can develop learners' problem-solving skills with detailed explanations and solutions related to the problems to encourage them to think out of the box rather than memorize. Besides, Xu et al. (2024) also highlighted the benefit of large language models for personalized learning support based on learners' needs by understanding their learning behaviors inlcuding the strengths and areas of improvement to generate suitable learning materials and adaptive study plans. Unlike traditional methods that require learners to follow a fixed timetable, large language models can dynamically adjust study plans based on their progress and create diverse learning resources like text and quizzes.

The evolution of artificial intelligence in education has progressed from machine learning to deep learning and now to large language models, and these emphasize personalized learning (Xu et al., 2024). As per study done by Ingkavara et al. (2022), a personalized learning approach can be applied by allowing learners to define learning goals and allocate study time based on their ranking of the subject from strongest to weakest. In this case, artificial intelligence is used to analyze this data to identify weak areas and generate a personalized study plan timetable for each learner. By leveraging large language models, the timetables can be further optimized by balancing the difficulty of study sessions on available slots of the current timetable. The learners can benefit from real-time adjustments, personalized recommendations, and optimized learning paths.

However, there are many challenges to creating and developing an adaptive personalized e-learning approach. Firstly, it is difficult to determine the right set of features for personalized recommendations to each learner. Thus, there is a need for frequent data collection when implementing the LLM-powered personalized learning approach to ensure real-time adaptation but this can overwhelm the learner through continuous assessment (Murtaza et al., 2022). Additionally, when learners gain more knowledge, the system needs to update learner preferences from time to time and validate its accuracy. This is important to prevent incorrect learning recommendations for learners which can slow down their learning progress.

2.4.3 LangChain Framework for Large Language Model in AI-Powered Study Plan Timetables

The large language model is a type of artificial intelligence model that is designed to understand natural language to generate human-like text as output. However, accessing a large language model requires a framework to connect, manage, and optimize interactions with data, APIs, and applications, and thus the LangChain framework is introduced to overcome the limitations (Auffarth, 2023). The models like Gemma, Llama, and Qwen are a raw model that needs infrastructure to process inputs and interact with external data sources to generate outputs. LangChain can act as a middleware to integrate these models into a web application by providing a structured approach for the AI-powered study plan timetables. According to Mavroudis (2024), this framework also provides prompt templates to structure inputs to ensure consistency before sending them for processing. This allows dynamic insertion of learners' specific details like available study time for each subject and difficulty levels in order to customize the study plan timetable.

It might be challenging to deal with dynamic or real-time as the models do not have built-in access to external knowledge (Mavroudis, 2024). In this case, LangChain allows the models to fetch and access up-to-date data either from databases or APIs as it supports Retrieval-Augmented Generation (RAG) to adjust study plan timetables accordingly. When a learner updates their preferences, the latest data from the database will be retrieved for the models to

regenerate the study plan by reallocating study sessions and adjusting time for revision.

Besides, LangChain also supports hybrid deployments as it allows the models to run both locally and on cloud platforms. When running local models, LangChain provides full control of the model to ensure that data are not shared over the Internet. Besides, local deployment allows for prompt-engineering based on specific learning needs. Models can be trained for specific purposes to improve the accuracy of personalized study plan timetables. By reducing the dependency on the cloud, the subscription costs can be eliminated. However, for large-scale deployments, cloud deployment is a better choice but the network latency can impact performance to update the study plan timetable instantly.

2.4.4 Comparative Analysis of AI-Powered Study Plan Timetable Approaches

Table 2.2: Comparative Analysis of AI-Powered Study Plan Timetable Approaches.

Category	Open Source Model: LLaMa by Meta	Open Source Model: Qwen by Alibaba	Pretrained APIs on Hugging Face
Knowledge and Domains	Strong general knowledge, reasoning, tool use, and multilingual translation.	Strong in coding, math, structured reasoning, and multilingual tasks.	The domain expertise is inconsistent as it varies depending on the selected model.
Database Access	The direct integration with the database can be done via LangChain without external calls.		The database cannot be accessed directly as it depends on the API provider.
Customization	Both allow fine-tuning locally and prompt engineering for specific tasks.		The customization is limited unless

		fine-tuned separately.
Control	There is full control over model behavior if deployed locally.	There is limited control over model internals as it depends on pre-trained datasets and parameters.
Deployment	It can be self-hosted without vendor lock-in.	It is managed and hosted by Hugging Face.
Cost	There are no per-call charges.	The cost depends on the recurring API usage.
Privacy and Data Security	All data remains on local devices if deployed locally.	The data is sent to external servers and is dependent on third-party security measures.
Performance and Speed	There is no network delay and the response can be fast with powerful hardware if running locally but it depends on the instance type chosen for infrastructure when self-hosted.	The performance relies on server load and internet connection and may have latency due to multiple API requests since it depends on Hugging Face's cloud.

It is important to choose the right model framework to implement an AI-powered study plan timetable. The following shows the comparisons between a custom deployment of the open-source LLMs such as LLaMa and Qwen models

and the use of pretrained models via Hugging Face APIs based on knowledge and domain, direct access to the database, customization, control, deployment, cost, privacy, data security, performance, and speed.

To deal with an AI-powered study plan timetable, learners need to enter their current school schedules for the fixed time slots. After that, learners need to rank subjects from strongest to weakest based on difficulty. All these data are stored in the database, retrieved, and sent to the models for processing to generate a personalized and balanced study plan timetable for each learner. LangChain allows direct integration with the database to be done for the self-hosted open-source LLMs easily without relying on external API calls (Pinheiro et al., 2023). However, Hugging Face models with the hosted APIs cannot directly access the database unless there is a separate backend set up to query the database and send data to the model. Furthermore, the study schedules and rankings need to be sent to Hugging Face via API calls manually and this will make the process to become less efficient and costly due to repeated API usage.

In terms of customization and control, the open-source LLMs allow fine-tuning with the dataset by using logic to control the outputs and datasets to customize the study plan timetable. However, these are restricted to pre-trained models for Hugging Face APIs unless fine-tuning which is not replaceable by prompt engineering is done separately (Shashank Mohan Jain, 2022). Furthermore, the model might not be able to generate the optimal study plan timetable for learners if it was not trained on the study schedule and subject ranking.

For deployment, the open-source models support running locally and self-hosted and thus eliminate the costs of API call charges (Kumar and Ahmed, 2024). However, this requires high-end GPUs and hardware upgrades can be expensive at the same time. As hardware technology improves, local deployment or self-hosted is now able to provide flexibility to have complete control over the infrastructure and models anytime since there is no vendor lock-in (Li et al., 2025). Besides, since it is deployed on end devices, no personal data is sent to external servers, and all data collected from the learners can be kept securely by following data regulations like GDPR. In contrast, Hugging Face models are able to reduce hardware and maintenance costs when deployed on the cloud. The recurring cost needs to be taken into consideration as it is

charged based on API calls, which becomes expensive when the number of users increases. Although cloud providers offer encryption to secure data, the data is sent to external servers and might be at risk if the provider is hacked.

For performance and speed, there is no network delay when using the open-source models since everything runs on end devices. This provides immediate responses and makes study plan time adjustments much faster, especially with high-end GPUs. However, for large-scale models, Hugging Face is better but Llama can match speed if running on a strong local GPU.

In conclusion, LLaMa and Qwen were selected for comparison because both are the most recent and competitive LLMs that can be applied in academic contexts by providing better accuracy for personalization due to its prompt engineering capabilities. In this case, models from Hugging Face are only accurate if it is prompted and pre-trained with the study plan timetables. Besides, LLaMa with improved prompt understanding offers strong efficiency while Qwen demonstrates advanced reasoning and multilingual support. Thus, comparing these two models can provide a balanced perspective on their respective strengths.

2.4.5   Weighted Scoring Model for Performance Evaluation

A Weighted Scoring Model (WSM) is a multi-criteria decision-making method which is commonly used in system evaluation, software selection, and AI model performance comparison. It is useful in prioritizing options by assigning scores to several criteria where each of them is given a weight based on its importance (Ouchra and Belangour, 2021).

The scoring system provides a way by implementing a data-driven approach through flexibly quantifying subjective factors (Gonzalez de Villaumbrosia, 2025). It is important to ensure the decisions are made based on logic and analysis rather than intuition. However, not all factors can be quantified and measured. It may oversimplify complex decision-making processes, although assigning weights to criteria helps to reflect goals. For example, qualitative aspects like user satisfaction, adaptability, and long-term sustainability may not be captured by the scoring system. As a result, it should be applied as a complementary tool with qualitative assessments in order to provide a more holistic and balanced evaluation.

The implementation involves several steps. The first step is to identify the factors that are the most relevant for evaluation. Then, weights are assigned to each criterion based on its relative importance. Once the criteria are finalized together with their weights, the score for each task against the criteria needs to be evaluated. Following this, the weighted scores are calculated using the formula:

$$\text{Weighted Score} = \sum (\text{Score}_i \times \text{Weight}_i)$$

Finally, the total weighted score for each option is compared. The highest score indicates the most suitable or best-performing alternative to be considered.

2.5   Review of Web Development Frameworks

2.5.1   Overview of Web Development

The process of designing, implementing, testing, and building applications that are accessible through web browsers on any device is known as web application development. The database management, frontend, and backend are usually included in the process. Developers can access powerful tools and development frameworks to simplify code and ensure high performance and maintainability as web technology continues to grow over the time. This is important to ensure that web applications are developed with high scalability, security, and efficiency. Besides, in web development, frameworks are important in providing pre-built structures, libraries, tools, and reusable components to standardize coding practices. This is because using frameworks are able to reduce development time through the implementation of built-in features to ensure code readability.

2.5.2   Categories of Web Development Frameworks

Both backend and frontend are two important aspects of any web development. According to Amazon Web Services (2024), the backend is the server-side logic and database that is stored and processed behind the scenes to make the web function that cannot be seen directly by users. The backend frameworks are responsible for handling server-side logic, database interactions, and API integration. Django, Laravel, Node.js, and Spring Boot are popular backend frameworks and have often been used in recent years. Also as described by

Amazon Web Services (2024), the frontend is what users directly see and interact with, like visual elements such as checkboxes, buttons, navigation menus, and any dynamic content updates within the web. Frontend frameworks like React, Vue, and Angular with component-based architectures are widely used to create dynamic and interactive user interfaces while ensuring responsiveness and better user experience within the web application at the same time. Every framework has different purpose and is chosen according to development preferences and project requirements.

2.5.3 Comparison of Popular Backend Frameworks- Django, Laravel, Node.js, and Spring Boot
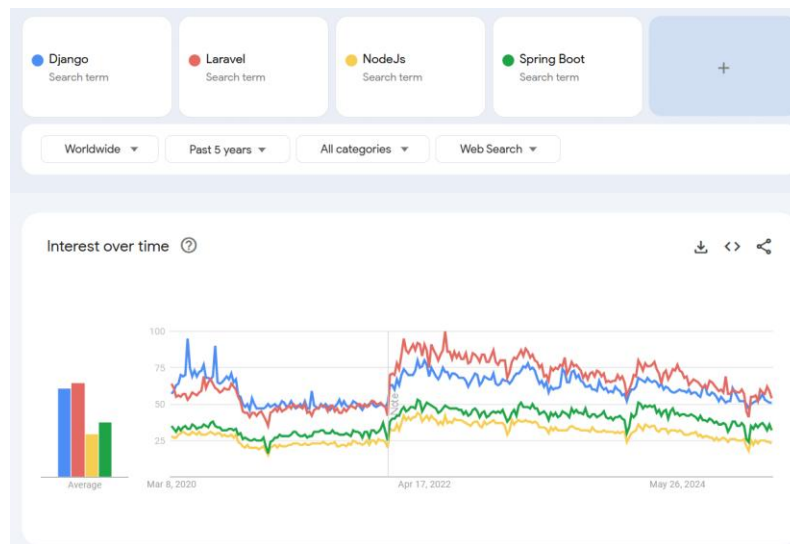
Figure 2.1: Comparison of the Popularity of Four Backend Frameworks Over the Past Five Years.

Django, Laravel, Node.js, and Spring Boot are the most common backend frameworks used for web development. The figure above shows the comparison of the popularity of Django (blue), Laravel (red), Node.js (yellow), and Spring Boot (green) over the past 5 years worldwide. Based on the analysis, Laravel has the highest search interest among the four backend frameworks which is noted by a significant peak around April 2022. Django is the second most popular backend framework that has maintained slightly below Laravel in recent years. However, Node.js and Spring Boot are less searched compared to Laravel and Django.

Table 2.3:   Feature Comparison of Django, Laravel, Node.js, and Spring Boot.

Feature	Django	Laravel	Node.js	Spring Boot
Language	Python	PHP	JavaScript	Java
Architecture	Model-Template-View (MTV)	Model-View-Controller (MVC)	Event-driven, Non-blocking	Model-View-Controller (MVC)
Database Support	SQL	SQL	NoSQL & SQL	SQL
Security	Built-in protection like CSRF, XSS, SQL injection	Middleware-based	Third-party modules	Enterprise-grade security
Performance	High but slower than compiled languages	Moderate	High due to non-blocking I/O and support for asynchronous	High due to Java Virtual Machine (JVM) optimizations
Ease of Learning	Easy as Python is beginner-friendly	Easy as using PHP syntax	Easy to moderate due to JS-based	Difficult due to Java complexity
Use Case	Data-driven application	Web applications	Streaming applications, and microservices	Large-scale systems, and enterprise applications
Deployment Complexity	Low with built-in server	Low with built-in command	Low with Node Package Manager (npm)	High as requires Java environment and dependencies

Django uses Python programming languages thus making it easier for beginners to learn in a short time. It is one of the open-source web development frameworks by follows the Model-View-Template (MVT) to define views and templates in creating user interfaces. In this case, the views are used to transfer data to templates which are rendered to send HTML replies to the user later on (Chen et al., 2020). Additionally, according to Chen et al. (2022), Django consists of built-in features such as authentication, URL routing, Object Relational Mapper (ORM), and security mechanisms like SQL injection prevention and data validation which are useful for rapid development. Besides, Django is well known for its automatic CRUD operations where the creating, reading, updating, and deleting processes are done through an administrative interface without requiring backend development (Madurapperuma et al., 2022). Additionally, the functionality and layout of the Django Admin Panel can be adjusted although it is a predefined interface, making it highly customizable. This makes Django a useful framework in the development e-commerce platform that is data-driven.

Laravel is a popular PHP framework used for backend development that follows the Model-View-Controller (MVC) architecture. By creating RESTful APIs, it is able to serve data to a React frontend and embed React components within Blade templates. According to Madurapperuma et al. (2022), Laravel comes with comprehensive documentation that allows the developers to learn within a short time. One of its popular features is the Eloquent ORM which simplifies database interactions by allowing the developers to deal with short syntax rather than raw SQL queries. Madurapperuma et al. (2022) also stated that the page load time is better in a PHP-based web application compared to the one built with .net, making it highly suitable for web application development. Besides, middleware in Laravel is used as the filtering mechanism for handling HTTP requests and responses without modifying the core application logic. This is important in ensuring modularity by keeping the application logic clean while ensuring security and performance at the same time.

Besides, Node.js is a JavaScript runtime environment that is highly suitable for handling real-time applications like instant messaging and live streaming (Anh, 2021). Its single-threaded and non-blocking I/O features,

which are able to manage several requests at once without generating extra threads to speed up response times make it so popular. Furthermore, Node.js comes with the Node Package Manager (npm) that offers a variety of libraries to simplify development tasks. However, compared to other backend frameworks, it is lacking structured and up-to-date documentation even though the official documentation provides detailed API references (Madurapperuma et al., 2022).

Spring Boot is a common Java-based backend framework which is used for building enterprise applications and large-scale systems (Muittari, 2020). This backend framework is built on Spring Framework and follows the Model-View-Controller (MVC) like Laravel. It has its own embedded servers and thus eliminates the need for external web server configurations, and increases the deployment complexity at the same time. However, it is difficult for beginners to learn especially with the lack of Java fundamentals as it heavily relies on core Spring concepts, thus making it highly complex.

2.5.4 Comparison of Popular Frontend Frameworks- React, Angular, and Vue
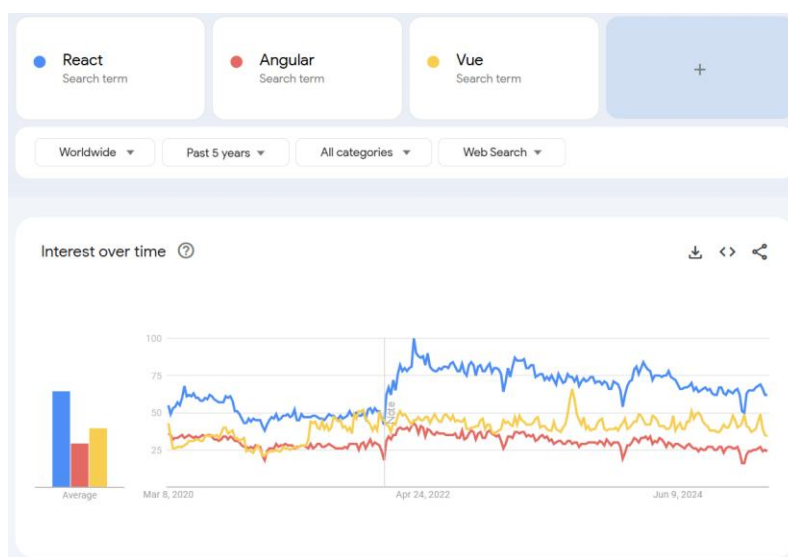
Figure 2.2: Comparison of the Popularity of Three Frontend Frameworks Over the Past Five Years.

React, Angular, and Vue are the common frontend frameworks used for web development. The figure above shows the comparison of the popularity of React

(blue), Angular (red), and Vue (yellow) over the past 5 years worldwide. Based on the analysis, React is the widely used frontend framework and has the highest search interest among the three. The search interest for React was raised around April 2022 and it continues to remain dominant over the other frontend frameworks. Although Vue is the second most searched frontend framework, it still has more search interest than Angular most of the time. However, Angular has the lowest search interest compared to React and Angular and shows a gradual decline over time.

Table 2.4:   Feature Comparison of React, Vue, and Angular.

Feature	React	Vue	Angular
Developer	Meta	Evan You (Open-source community)	Google
Language	JavaScript/ TypeScript	JavaScript/ TypeScript	TypeScript
Framework Type	Component-based UI with Library	Progressive framework	Full-fledged framework
Performance	High with virtual DOM and optimized rendering	Fast with lightweight and virtual DOM	Moderate with two-way data binding adds overhead
Architecture	Component-based (View layer only)	Component-based (Model-View-View Model)	Component-based (Model-View-Controller)
Complexity	Moderate learning curve	Simple learning curve	Steep learning curve

Khan and Khanam (2023) mentioned that the Model-View-Controller (MVC) architecture divides an application's functionality into three interrelated parts which are the Controller, View, and Model. In this MVC architecture, the controller is able to receive user input and control the flow of the application,

the view handles the presentation layer, while the model represents the data and business logic. This architecture is able to simplify the process of development as it offers predetermined structures and libraries to build a web application that is safe, scalable, and easy to maintain by making code reusability possible. According to Vyas (2022), React is the frontend framework that implements the View component of MVC architecture while Vue focuses on the view and model layer of the MVC architecture. However, there are fewer packages developed for Vue as it is less popular than React, making it difficult to choose packages that offer functionality relevant to a given situation during development. Other than that, this architecture is fully functional with Angular because Angular is built on MVC, thus making it easy to update and change views without the need to rebuild from scratch (Vyas, 2022).

React is the free and open-source JavaScript library used for frontend development to build dynamic and interactive user interfaces by following a component-based architecture (Fariz et al., 2022). There are two types of components which can be classified into class components and functional components which make the development more modular. The components created using classes or functions allow developers to divide the user interface (UI) into more manageable and reusable parts. Besides, Fariz et al. (2022) also mentioned that each of the components has a component lifecycle of mounting, updating, unmounting, and error handling which can receive inputs as props, manage its state, and return React elements that can be displayed on the screen. This makes React to become more popular than Angular which does not allow much modification as it saves time for development by reusing components for the same features.

Vue can be considered a systematic framework that falls somewhere between Angular and React in terms of complexity and structure. Vue is the same as React which follows a component-based but uses a more lightweight virtual Document Object Model (DOM) to represent a page into objects (Vyas, 2022). Thus, Vue is more suitable to be used for lightweight applications where fast rendering and minimal overhead are prioritized (Madurapperuma et al., 2022). Besides, like Angular, Vue provides more built-in features by reducing the need for external libraries which is useful for developing larger applications.

It is also a well-documented framework that enables beginners to learn in a short time.

Angular can be described as the biggest frontend framework in this comparsion. It is also known as a full-fledged framework that provides various built-in functionalities such as routing, state management, form validation, and sending Ajax HTTP requests (Vyas, 2022). These make Angular to be more suitable for custom software development as the whole page will not be refreshed when the user navigates, allowing it to work faster. Besides, the large bundle size and performance overhead can influence loading speed, making it less ideal for lightweight applications. However, Angular constantly updates by introducing major modifications making developers take longer to adapt to them (Hutagikar and Hegde, 2020). Thus, it can be challenging for beginners compared to Vue or React.

2.5.5   Findings of Web Development Frameworks

For backend development, Laravel will be used as it follows the MVC architectural pattern. It can also integrate with frontend frameworks like React for designing interfaces and ReactStrap for responsive user interface design. These can help to ensure the code is efficiently and make the gamified e-learning platform more maintainable.

2.6   Review of Existing E-Learning Platforms

As technology keeps changing the way of learning, e-learning platforms have become a key part of education, providing learners with more flexible and interactive ways to learn. All existing learning platforms are designed to meet different learning requirements by following a structured and planned course, studying at their own pace, or having fun with game-like activities. These platforms are very beneficial to students in secondary education. The following is a list of selected e-learning platforms that are widely used in secondary education:

1. EduNation (https://www.edu-nation.net/)
2. FrogLearn (https://frogeducation.com/)
3. Google Classroom (https://classroom.google.com/)
4. Kahoot (https://kahoot.com/)

5. Khan Academy (https://www.khanacademy.org/)

6. Moodle (https://moodle.org/)

7. PasXcel (https://pasxcel.com/)

8. Snapask (https://snapask.com/en-my/)

9. SPMflix (https://www.spmflix.com/)

10. Tuisyen.my (http://tuisyen.my/)

2.6.1 EduNation, FrogLearn, Google Classroom, and Moodle
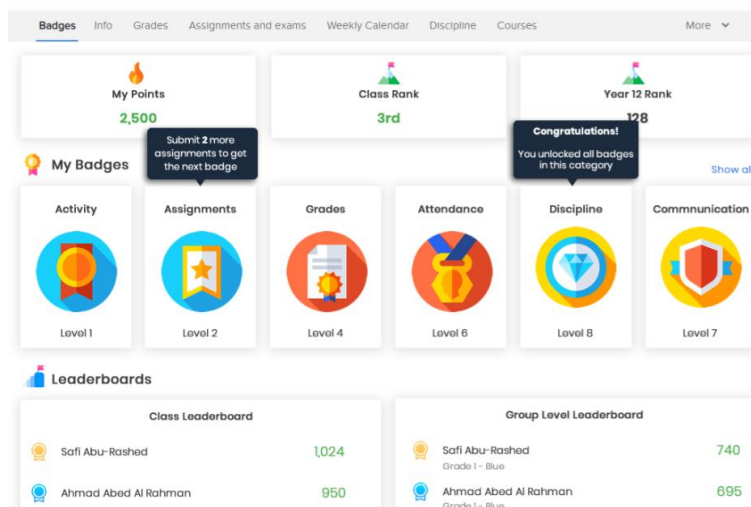
Figure 2.3: EduNation Reward System and Gamification.

Figure 2.4: Features Provided by FrogLearn (Frog Education, 2025).
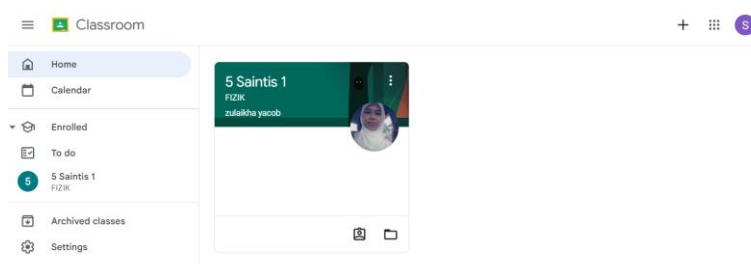
Figure 2.5: Google Classroom Class Organization.
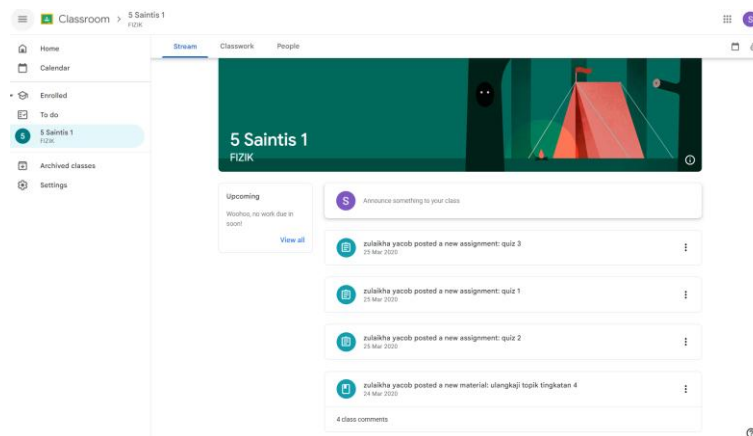
Figure 2.6: Google Classroom Class Layout
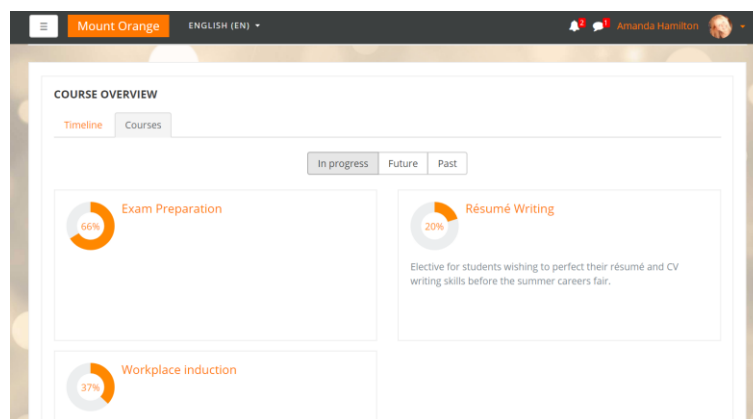
Figure 2.7: Moodle Course Overview Dashboard Layout.

EduNation, FrogLearn, Google Classroom, and Moddle are Learning Management Systems (LMS) designed to enhance the e-learning process for educational institutions. These e-learning platforms provide a centralized space by allowing course management such as creating assignments and quizzes, distributing learning materials, communication, and collaboration between instructors and learners. Learners can submit assignments and their performance can be monitored. In this case, Moodle allows learners to have clear overviews of their progress history by providing a dashboard for tracking and monitoring their learning journey.

Each LMS also supports discussions between learners and instructors via comments and forums to ensure that learners can interact with instructors. All these systems have built-in calendars and notifications to remind learners of

deadlines and scheduled activities. Among the four platforms, EduNation is the only one that includes gamification elements such as points, badges, and leaderboards to boost motivation for learners to engage in online learning. In terms of pricing, EduNation follows a pay-as-you-go model with an annual pricing structure based on the number of learners enrolled. FrogLearn is a paid subscription service that offers free templates that are ready to be used by institutions through customization to fit their specific needs and requirements. However, both Google Classroom and Moodle are free of charge.

2.6.2   Kahoot!
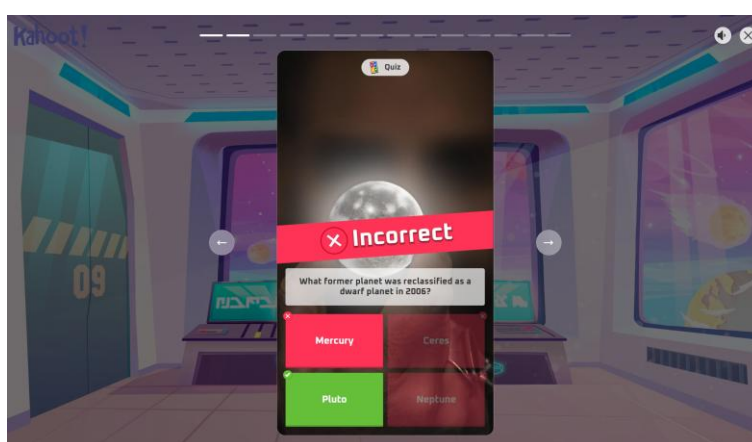
Figure 2.8:   Kahoot! Instant Feedback Quiz Attempt Interface.

Kahoot! is the most popular game-based e-learning tool to enhance the process of teaching and learning via quizzes, polls, and challenges for secondary education in Malaysia. If combined with gamification elements such as leaderboards, points, and timers, the learners are participative in a more interesting way to learn. In the platform, the learners are able to participate in real-time quizzes which are hosted by instructors, or complete self-paced challenges to improve the overall learning experience. Besides, it also supports course management features by allowing instructors to create and customize quizzes to track learner performance and provide automated feedback after each question. It is free of charge for common features but the learners can pay to upgrade to explore further features.

2.6.3   Khan Aacademy
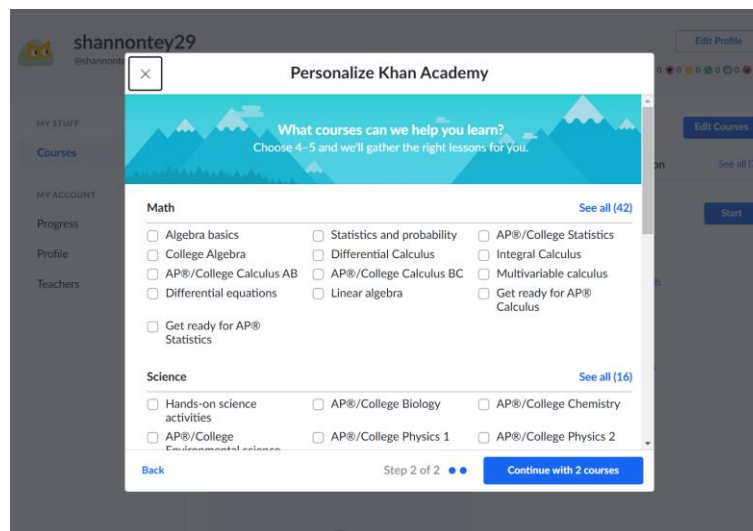
Figure 2.9: Khan Academy Course Personalization Selection Interface.
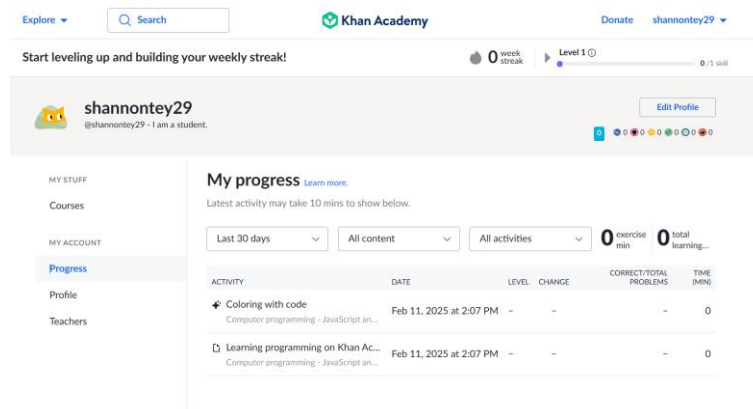
Figure 2.10:   Khan Academy User Profile Interface.

Khan Academy is a free personalized learning platform for learners from different age groups by allows them to study flexibly and receive AI-powered course recommendations based on their progress and area of interest. The learners can choose to join courses based on their area of interest and the history can be reviewed in their profile. Khan Academy also includes course management features and enables learners to track their study progress for the latest 30 days. Khan Academy takes in a few gamification elements such as weekly streaks, levels, and badges that learners earn after completing exercises or quizzes while receiving instant feedback.

2.6.4 PasXcel

Figure 2.11:　　　PasXcel Learning Packages and Pricing.

PasXcel focuses on the online homeschool concept to provide high-quality education for IGCSE students with charges varying based on the selected package and included features. This online homeschool concept provides a fully online learning experience with small class sizes for the learners. PasXcel provides basic features like course management, downloadable notes, quizzes, and exercises to support learning. In this program, all instructors are verified, and progress reports are certified and sent via WhatsApp and email manually upon request. However, there is also another limitation as well where direct communication between the learners and their instructors is only available through external platforms like Discord, email, and Zoom meetings after school hours.

2.6.5   Snapask
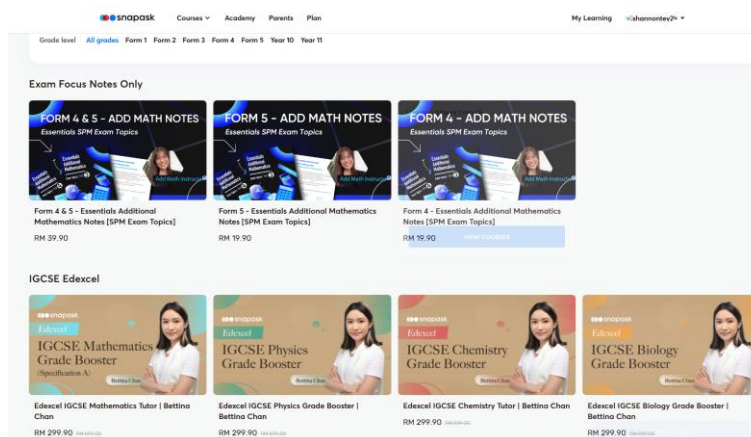
Figure 2.12:   Course Selection Interface on Snapask.
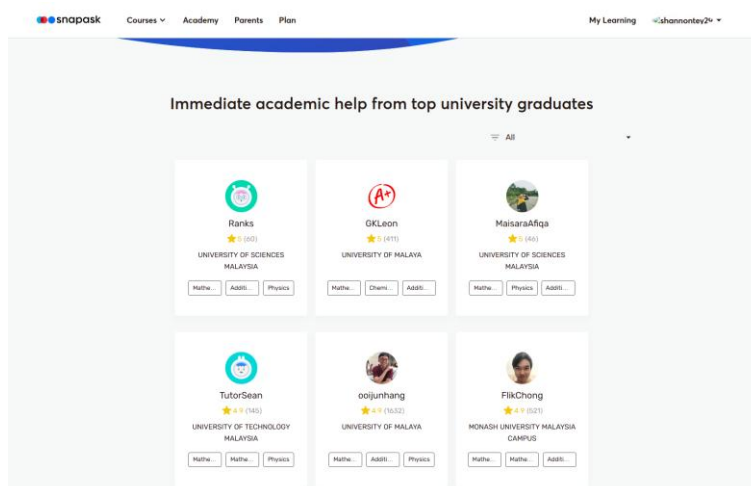
Figure 2.13:   List of Verified Instructors on Snapask.

Snapask is a paid e-learning platform where learners pay based on the courses they take to allow them to choose what they need without the need for a full subscription. All instructors on Snapask are verified to ensure all learners receive high-quality support. This platform also provides features like course management, downloadable notes after purchase, and quizzes. The learners can message instructors instantly, join discussion forums, and go for one-on-one learning sessions for more personalized support. Besides, it also provides multiple languages to make it accessible to various groups of learners.

2.6.6   SPMflix
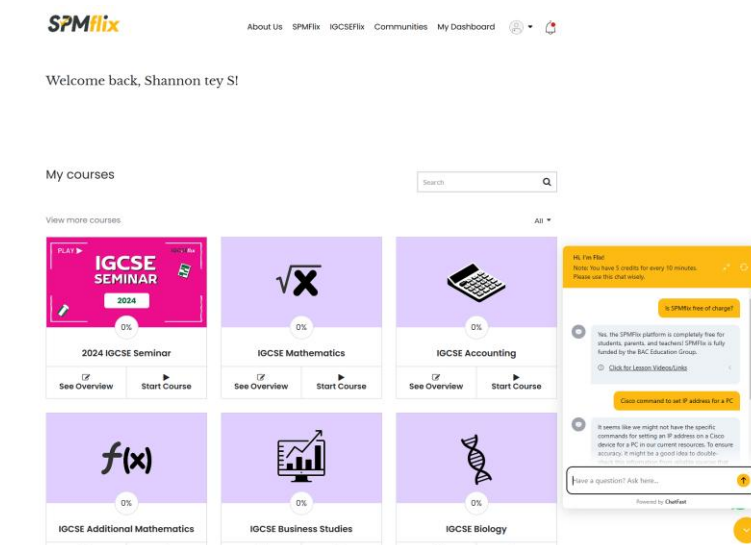
Figure 2.14:   List of Courses Interface Layout on SPMflix.

SPMflix is an e-learning platform designed for secondary school learners, particularly SPM and IGCSE candidates in Malaysia. It provides free educational resources which include video-based lessons based on the SPM and IGCSE syllabus, additional notes, quizzes, exercises, study seminars, and an AI chatbot without charge. The AI chatbot can respond to inquiries about the platform and answer basic knowledge questions. All enrolled learners can engage with the community to seek guidance from instructors and get replies within 24 hours. Additionally, they can track their study progress through certificates earned and course participation history in the profile section.

2.6.7   Tuisyen.my
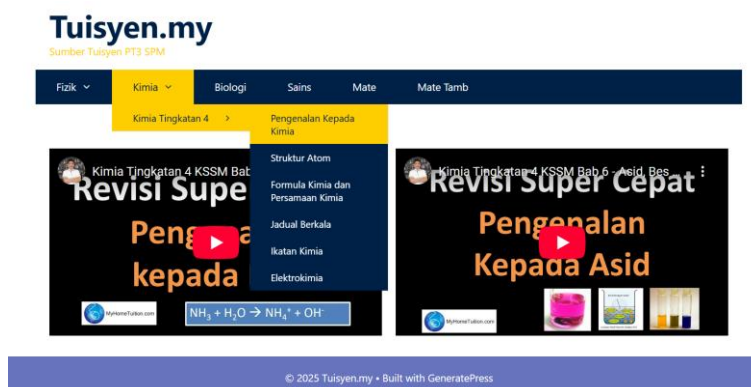
Figure 2.15:   Tuisyen.my Interface Layout.

Tuisyen.my is a website-based learning platform that offers a very simple and clean interface for learners. There is only a minimalistic layout with a header at the top for navigation. The limitation is that it only provides learning materials in the form of YouTube videos hence reducing the interactivity. The learners cannot participate in the content through quizzes, exercises, or discussions directly within the platform. Since not all YouTube videos are created by verified educators, there are potential issues such as inaccurate or outdated information. If the content creators remove the videos, learners may lose access to that content. Besides, Tuisyen.my only supports five subjects in a single language which will restrict learning options for learners who prefer other languages.

2.6.8   Findings of the Comparison of Existing E-Learning Platforms

Table 2.5:   Feature Comparison of Existing E-Learning Platforms.

Platforms/ Features	Course Management	Download Learning	Quizzes/ Exercises	Assignment Submission	User Progress Tracking	Gamification Elements	Certification Issuance	Built-In Calendar	Notifications	Teacher/ Tutor Support	Teacher Status Verification	Automated Feedback	Instant Messaging	Community/ Discussion Forum	Free of Charge	AI Assistance
EduNation	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No	Limit
FrogLearn	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Google Classroom	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No
Kahoot!	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	Yes	No
Khan Academy	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No
Moodle	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Limit
PasXcel	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No
Snapask	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	No
SPMflix	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Limit
Tuisyen.my	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No

The comparison table highlights the key features of various existing e-learning platforms that are commonly used in secondary education. Mostly all of the platforms examined provide essential features like course management, downloadable learning materials, quizzes, or exercises. However, not all platforms support assignment submission, user progress tracking, certification issuance, or AI assistance. Even with the presence of AI features, those are only limited to chatbots and course recommendations rather than personalized study plan timetables. Besides, gamification elements such as scores, streaks, badges, and leaderboards are only present in EduNation, Kahoot!, and Khan Academy. At the same time, the certification issuance is mostly absent among the studied e-learning platforms, except for SPMflix. The built-in calendars are available in EduNation, Google Classroom, and Moodle for reminder and scheduling, while notifications are a common feature on most platforms. Teacher or tutor support is available on most platforms, except for PasXcel and Tuisyen.my, but only a few provide teacher status verification, instant messaging, and community or discussion forums. Regarding the pricing, Google Classroom, Kahoot!, Khan Academy, Moodle, and SPMflix are free, while the others are based on the courses subscribed to or learning packages provided.

Based on the analysis, none of the platforms currently offer a personalized AI-generated study plan timetable which could be an attractive feature for learners to stay engaged in online learning that matches their individual learning needs.

2.7 Review of Software Development Methodology

2.7.1 Waterfall Software Development Methodology
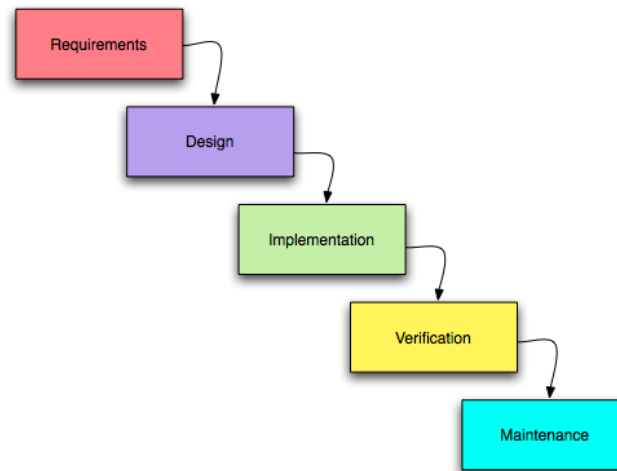
Figure 2.16:   Waterfall Software Development Process (Hughey, 2009).

Hughey (2009) stated that the waterfall model is the first process model introduced by Winston W.Royce in 1970. This approach is the most traditional approach which implements the linear and sequential life cycle model. Each phase must be completed before entering the next phase as this approach follows a structured sequence throughout the software development life cycle.

Firstly, the greatest advantages of the waterfall model are the clarity and predictability. All requirements are specified during the early phase of the project which is able to prevent the scope change during the late stage (Senarath, 2021). Additionally, Hughey (2009) also mentioned that the waterfall approach is able to ensure the team has a clear understanding regarding the project scopes and requirements which makes the project more predictable in different aspects such as the project timelines and costs needed.

However, there are some limitations during the implementation of the waterfall model. The requirements are more difficult to specify during the early phase of some projects due to various factors (Aroral, 2021). In addition, since this model is linear and sequential, thus make it more difficult to apply the changes to the project once the development stage has started. Since the feedback and testing are given and conducted during the implementation of this model, it might cost the project team more time and resources to fix the

problems due to the lack of flexibility that makes the adjustments towards the project more difficult (Senarath, 2021).

2.7.2   Parallel Software Development Methodology
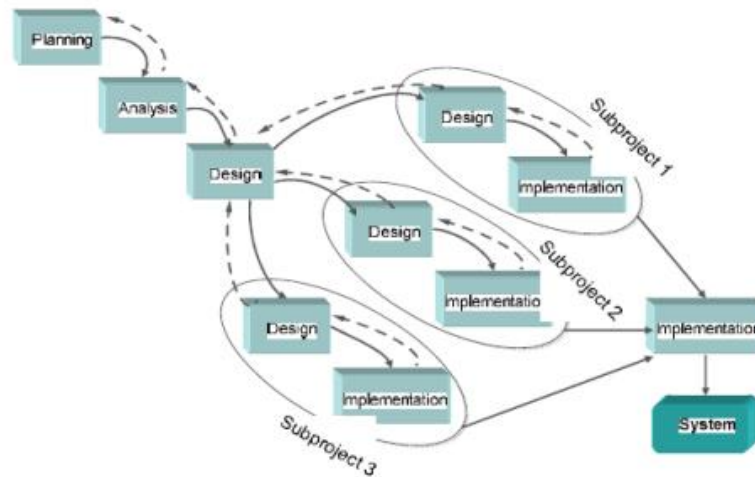
Figure 2.17:   Parallel Software Development Process (Nugroho, Hadi and Hakim, 2017).

Parallel software development is also known as a methodology that divides projects into smaller and parallel tasks that can be developed simultaneously (Nugroho, Hadi and Hakim, 2017). This model is designed so that the limitations posed by the waterfall model can be overcome by allowing multiple components of the software to be developed at the same time. This is able to reduce the overall development time to make sure that the final product can be delivered to the client on time.

Parallel development offers the advantage as it is able to speed up system development by dividing and distributing tasks to reduce dependencies by switching through different tasks (Indeed Editorial Team, 2024). Working on different tasks simultaneously requires a high focus on core functionalities and expanding it later. Implementing the parallel approach can shorten the project timeline as potential issues may be identified and fixed earlier. This effort helps to minimize the cost since issues are detected earlier, resulting in fewer changes and refinement later in the project.

However, one of the key challenges to consider with parallel development is delaying system delivery. According to Nugroho, Hadi and Hakim (2017), the overall system delivery can take a longer time using the waterfall model due to the complexity of managing multiple subprojects. Thus, this model may not be the most ideal choice for more complicated projects due to difficulties in coordinating multiple subprojects. If one of the subprojects faces issues or delays, it can impact the integration of the entire system.

2.7.3   Prototyping Software Development Methodology
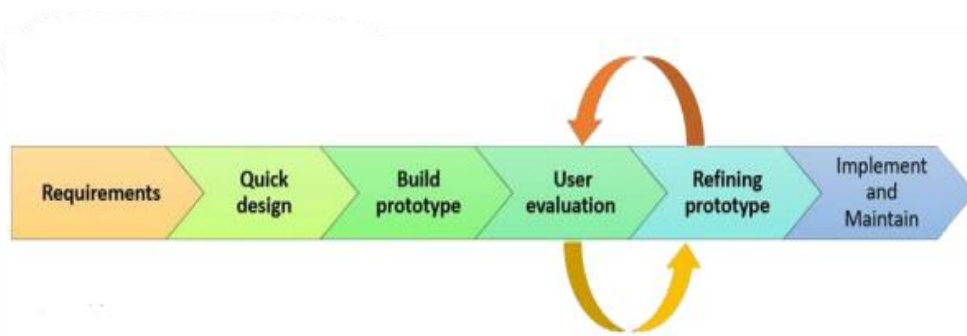
Figure 2.18:   Prototyping Software Development Process (Senarath, 2021).

According to Senarath (2021), prototyping is a software development methodology that builds a prototype as the initial version of the software before developing the final product. In the prototyping development, the prototype is built, tested, and refined through multiple iterations until an acceptable prototype is achieved by meeting expectations.

There are four types of prototyping models in this methodology. GeeksforGeeks (2018) mentioned that incremental prototyping breaks the final product into smaller prototypes that are developed and tested individually before merging, while extreme prototyping, which is mainly used for web development, ensures fast and structured delivery. Rapid throwaway prototyping is used to gather customer feedback at the earlier development stage to eliminate design flaws in ensuring a higher quality final prototype, although it may not be included in the final product, while evolutionary prototyping develops prototypes and refines based on provided feedback until accepted (GeeksforGeeks, 2018).

The prototype is an early and functional model that serves as a base that gives stakeholders a chance to interact with the system to collect feedback for improvement. One of the benefits is better requirement understanding. When stakeholders are uncertain about their exact needs, the iterative process enables continuous refinement based on real user feedback to ensure that the final product aligns with expectations (Gurung, Shah, and Jaiswal, 2020).

This software development methodology can be time-consuming. Although prototyping can save time in some situations, creating multiple versions of a system requires additional effort, which can delay the overall development and project timeline. The development teams may end up spending more time to refine prototypes than focusing on building the final product. As a result, the project may have a high chance to face delays, and additional costs may be required to accommodate the extended development process.

2.7.4   Agile Software Development Methodology
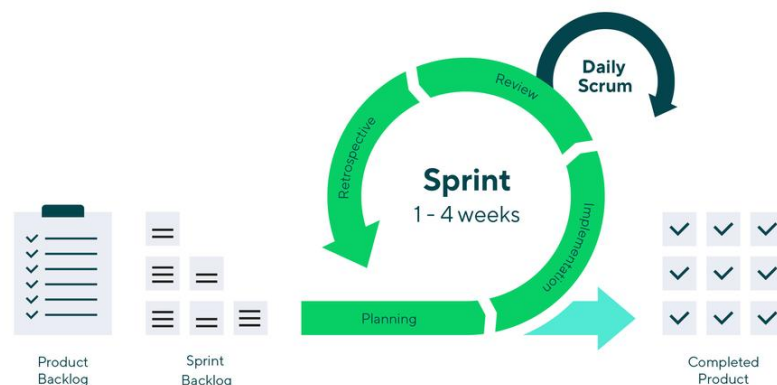
Figure 2.19:   Agile Software Development Process (Gurnov, 2024).

Singh (2021) described the agile software development methodology as an iterative, incremental, and adaptive process as it holds space for changes in requirements in terms of customer feedback and shifting business requirements. Besides, agile highly emphasizes the importance of testing and efficient practices during development. It is built on four core values including simplicity, effective communication, continuous feedback, and courage in adapting to changes.

One of the major advantages of agile is its fast iterations where the first deliverables are produced within weeks rather than months by ensuring the final version of each iteration is usable software (Džanić, Toroman and Džanić, 2022). The continuous feedback loop enhances product quality and ensures a high degree of client satisfaction through frequent refinement based on user input. This iterative approach motivates the developers to focus on producing functional solutions rather than spending excessive amounts of time on documentation.

However, agile also has its disadvantages although it provides flexibility and adaptability. The reduction in documentation makes the teams rely more on what they remember rather than written records, potentially causing issues in the long run (Gumiński, Dohn and Oloyede, 2023). Additionally, Singh (2021) mentioned that delivering work in increments or iterations makes it difficult to track project progress, requiring team leads to look across multiple cycles to monitor various features and developments. As a result, it might not be ideal for teams that need more structure and clear guidelines since agile works better with highly skilled and independent team members.

2.7.5   Scrum Software Development Methodology
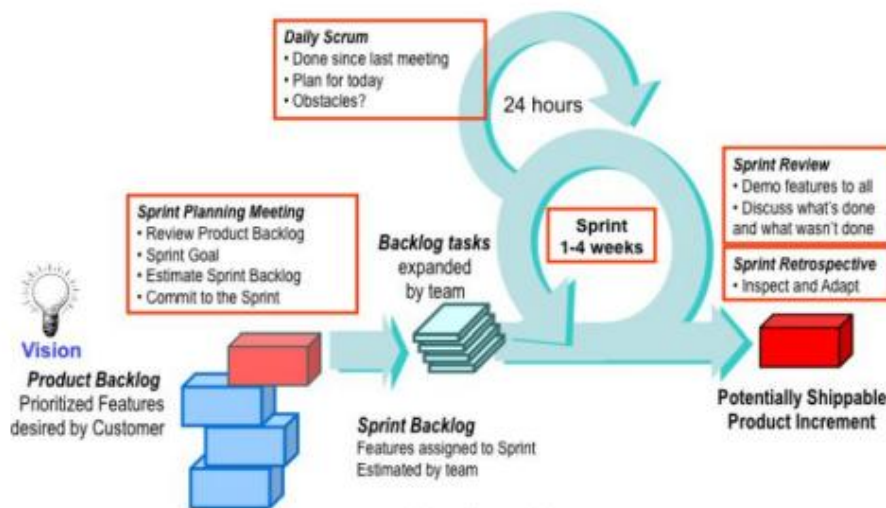
Figure 2.20:   Scrum Software Development Process (Hema et al., 2020).

Scrum is one of agile's frameworks for software development emphasizing iterative progress and collaboration. According to Hema et al. (2020), its working nature includes defining a set of product backlog features within the

sprint which represents a prioritized list of high-level customer needs. This structured approach organizes the whole development process into fixed-length cycles called sprints which last for one to four weeks to ensure that development remains focused on continuous delivery.

According to Chantit and ESSEBAA (2021), scrum development begins with sprint planning where the team selects tasks to be completed in the coming sprint from the product backlog and daily scrum meetings which are also known as daily stand-ups meetings are held for fifteen minutes to track progress, address blockers, and set goals for the day. By having regular scrum meetings, team collaboration can be encouraged as it ensures that all members are aware of their tasks and responsibilities in the project. However, meetings frequently can be a waste of time for larger teams reducing productivity by distracting attention and taking time away from actual work. Chantit and ESSEBAA (2021) also mentioned that the team would conduct a review session to demonstrate the completed work and a retrospective to reflect on future improvements. These iterative cycles are able to ensure efficient use of development resources of time and money by breaking up complicated projects into a few sprints that are easier for maintenance. Although scrum is highly adaptable and open to changing requirements by allowing changes to be introduced at any stage of the development, this flexibility can lead to uncontrolled scope creep if stakeholders continuously add or modify requirements.

2.7.6 Findings of Software Development Methodologies

Table 2.6: Comparison of Software Development Methodologies Based on Useful Criteria.

Usefulness for	Waterfall	Parallel	Prototyping	Agile	Scrum
Unclear User Requirements	Low	Low	High	Medium	High
Unfamiliar Technology	Low	Low	Low	Medium	Medium
High System Complexity	Medium	Medium	Low	Medium	Medium
High System Reliability	Medium	Medium	Medium	Medium	Medium
Short Time Schedule	Low	Medium	High	High	High
Transparent Project Timeline	Low	Low	High	Medium	High

In conclusion, the parallel software development methodology is chosen as it is most suitable and useful provided the project has a short development time. By following the parallel software development methodology, the development modules can be divided into smaller and manageable modules that can be developed simultaneously. This is because parallel software development methodology allows switching through different modules to develop higher priority functionalities as long as requirements and project scope are clearly defined. This can highly reduce dependency and save development time to ensure that the project can be delivered within the project timeline.

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1   Introduction

This chapter explains the reasons for choosing parallel software development methodology and its implementation from the initial planning phase to deployment. This section also discusses the project frameworks and development tools used for the gamified e-learning platform. Besides, a work breakdown structure (WBS) and Gantt chart are included for better tracking and project management.

3.2   Parallel Software Development Methodology
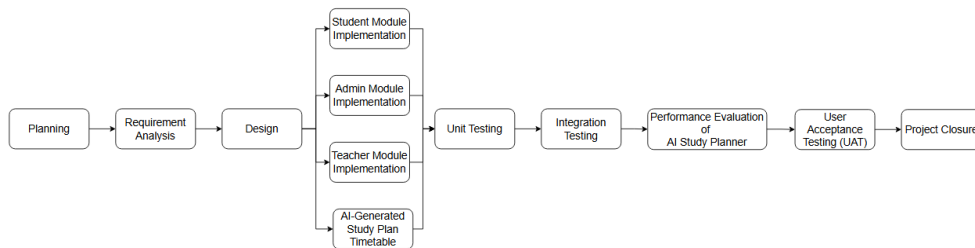
Figure 3.1: Parallel Software Development Process for Gamified E-Learning Web Application.

Through the study of different software development methodologies in the previous chapter, the parallel software development methodology is chosen for the gamified e-learning web application. This approach allows for faster and more efficient development by breaking the whole project into smaller subprojects to reduce the complexity and ensure multiple modules are developed simultaneously (Nugroho, Hadi and Hakim, 2017). As compared to sequential software development, where a single module is completed before moving on to the next, the three major modules for student, admin, and teacher are all done in parallel at once. This is due to only 14 weeks being allocated for the development, and hence, using the parallel approach can reduce overall development time while ensuring that every module is built independently without unnecessary dependencies. The parallel approach allows flexible

switching between modules to build on core and related functionalities and expand the features later on (Indeed Editorial Team, 2024). Besides, certain reusable components built initially can be shared across the three modules.

Since the modules are developed independently, the system remains flexible and able to be adjusted to adapt to new enhancements. Due to its nature of modularity and scalability, any necessary modifications or updates to the modules will not affect the functionality of the entire system. This makes the development process easier to introduce new features, such as gamification elements, an AI-generated study plan timetable, and personalized learning dashboards in the student module without affecting other core functionalities in the admin and teacher modules. This is because the parallel approach allows the refinement, replacement, and extension of individual components with the least effort. Besides, it also focuses on early testing and risk management. The unit testing will be conducted for each module before integration to ensure that errors are identified and resolved early in order to reduce the chances of entire system failures during the integration. The parallel software methodology process followed by this project will be explained in detail in Chapters 3.2.1 to 3.2.4.

In conclusion, using a parallel software development methodology makes sure that the project can be completed within the given time. It also promotes flexibility by allowing new features to be added to the specific module without major disruptions in the future. This facilitates the maintenance of the system by ensuring the smooth integration of new features.

3.2.1   Planning and Requirement Analysis

The project planning starts with the background study of the problem. This is to understand the context of the research topic which is the e-learning platform. This phase involves reviewing existing studies on e-learning, gamification, and personalized learning. Followed by this, a questionnaire is distributed to gather insights from potential users to understand their challenges, preferences, and their needs related to online learning. All data collected through this effort will be used to define the problem accurately. Following this, the problem statements are identified. Based on the problem statements, the project objectives and goals are established to provide a clear direction to work on. A project solution is then proposed by following the project approach suggested, which is the parallel

software development methodology. In this project, the e-learning platform is divided into three sub-modules, which are the student, admin, and teacher modules, to be implemented simultaneously and followed by integration. Additionally, the project scope is defined to specify the deliverables of the project. At the same time, the target users are determined to make sure that the proposed solution meets their needs before selecting features covered in the project. Furthermore, the development tools and frameworks required in this project are chosen. Then, the Work Breakdown Structure (WBS) is designed to break down tasks into smaller components that are easier to manage. It then comes out with a Gantt Chart to create a visual timeline for the project activities to allow progress tracking to ensure that the project can be delivered on time.

3.2.1.1 Literature Review

A literature review is done by focusing on three parts, which are e-learning, gamification, and personalized learning to explore existing research which helps to identify the best practices and understand how these concepts contribute to the most effective online learning. From the review, various online learning modes are examined, including their pros and cons. Also, the theories associated with the gamification elements and the impacts of each gaming feature on learners. Furthermore, research was done on AI-powered study plan timetables to understand how Llama models function in comparison to the Hugging Face models. Another study was conducted to examine the two popular models in terms of customization, control, deployment, cost, privacy, data security, speed, and performance.

3.2.1.2 Questionnaire

A questionnaire is distributed to 40 respondents using Google Forms so that feedback and data about learners' habits, challenges, and preferences in learning can be gathered and collected. The survey covers five sections. The first section is about general information like age, education level, internet access, and device ownership. Besides, academic performance by looking at SPM results, difficult subjects, and study motivation. The third section is about learning preferences to explore learners' study methods, used e-learning platforms, online learning experiences, and interests in AI-generated study plan timetables.

The next section is about gamification and motivation to study if gamification elements would increase learners' engagement in the learning process. Lastly, additional feedback is to get suggestions to improve online learning experiences. All data collected and insights gained will be further analyzed in the next chapter.

3.2.1.3   Review of Existing E-learning Platforms

A review of existing e-learning platforms is conducted to better understand the strengths and weaknesses of current e-learning platforms. This is an important approach in identifying key features that need to be included in the project and also the areas of improvement to be made. In this case, the method focuses mostly on gamification elements such as badges, leaderboards, and progress tracking and personalization, including AI-generated recommendations to analyze how these features are implemented in the e-learning platforms. This review is carried out through the analysis of ten popular e-learning platforms to examine the features offered, user engagement techniques, and limitations. This review is important so that the newly developed e-learning platform is an upgraded and better version of the existing one that is able to satisfy the needs of the learners. Additionally, the development risks can be lowered by guaranteeing that resources are allocated to necessary features rather than ineffective additions.

3.2.1.4   Use Case Diagram and Description

After identifying all functional and non-functional requirements, a use case diagram is designed using Entreprise Architect. This is able to provide a clear overview of how users interact with the e-learning platform. It is important to define the scope of the system by outlining the needed features that the platform offers. In every use case description, a detailed description of each use case is provided to explain in detail the flow of interactions which includes the actors involved, preconditions, necessary steps taken, and expected outcomes. This helps to better understand the functionality of the system to make the development more organized.

3.2.2   Design

The design phase of the project emphasizes the structure and visualization of how the e-learning platform will function. At the beginning of this phase, a high-fidelity prototype is being developed using Axure RP 9 to provide a preview of the user interface and an overview of the system flow. This includes the designation of the user interface for student, admin, and teacher modules before implementing it.

To achieve effective database management in this project, the Model-View-Controller (MVC) architecture is used as it provides a structured method of developing a web application using React and Laravel. This architecture separates the system into three main interconnected components. The first is the model which handles the database, then the view as a user interface, and the controller to handle business logic and user input processing. The separation promotes scalability, maintainability, and modularity since each component can be modified or updated independently without affecting the entire system. Furthermore, the separation of this structured approach can simplify the testing process because every component can be tested separately in the later phase.

Since the e-learning platform relies heavily on gamification elements like points, rewards, badges, progress bars, and levels, as well as managing courses and user data, therefore a well-structured database design is important. The entity-relationship diagram (ERD) is designed with Draw.io to show the relationship between different data entities, including the users, courses, assignments, and progress tracking. Following by this, a data dictionary will be created to provide a detailed description of the data elements which covers the definitions and characteristics within the database to ensure consistency. Then, the data flow diagram (DFD) will be designed to map out how the data flows through the overall system. This is able to helps to understand how information is processed, stored, and transferred within the web application.

3.2.3   Implementation and Testing

In this project, the student, admin, and teacher modules are developed independently by following the processes defined in the parallel software development methodology. This involves developing the frontend using React

and the backend using Laravel with WampServer for local development. The phpMyAdmin is used to manage the database to handle data for students, admins, and teachers. Besides, the three modules having different functions are worked on simultaneously to reduce dependency between modules and ensure efficient progress within the 14 weeks allocated. This enables reusable components like user profile components, file upload and storage for both instructors and learners, popups, and modal components for confirmations and error messages to be shared across modules to reduce development time. This approach is more suitable for enhancements and updates at a later stage, such as integrating an AI-generated study plan timetable, which is developed using the LangChain framework with the Llama model and a personalized dashboard for students in the student module without affecting other modules in the e-learning platform.

The unit testing will be conducted to identify and fix errors early before unit integration. This is done by testing every single function in all modules independently. Then, integration testing involves both the frontend and the backend. For the frontend, user interface functionality is being focused on since the project prioritizes gamification. For the backend, database queries and API responses using Postman will be conducted in order to verify and ensure proper data handling. API testing is important to ensure secure and accurate communication between different modules of the e-learning platform.

A performance evaluation will be carried out for the LLaMA and Qwen-based study planner. There will be a few evaluation criteria defined with their own weightage. Both models will be tested with the same set of inputs which will be executed across 10-20 rounds per model. The average accuracy score will then be computed for comparison to provide insights into each model's performance and reliability for personalized study planning.

After that, the selected model will be integrated to function as a complete gamified e-learning web application. This eases the process of identifying any inconsistencies or bugs during cross-module interactions. Finally, a user acceptance testing (UAT) will be conducted with actual users to gather feedback through the user satisfaction survey based on the System Usability Score (SUS) to allow necessary refinements before project closure.

3.2.4   Project Closure

The outcomes of the implementation and testing are important in indicating the completion of the project. It is important to make sure that the web application meets the requirements of students, administrators, and teachers. In this case, all issues identified during the testing will be addressed and all necessary refinements will be made to ensure the system's stability. At the end, the project documentation which includes the database, user manual, documentation, test reports, and feedbacks will be finalized.

3.3   Project Tools

3.3.1   Prototyping Tool

Axure RP 9 is used for creating either low or high-fidelity prototypes. It supports features by allowing the creation of dynamic interactions, animations, and conditional logic, such as form validations and page transitions. This makes the prototype feel and behave like a real web application in gathering feedback to refine the design before writing actual code.

3.3.2   Diagramming Tools

Draw.io and Enterprise Architect are chosen to design and draw entity-relationship diagrams (ERD), data flow diagrams (DFD), and other system architecture diagrams because both are open-source tools that are free to use. It provides various shapes, icons, and styles to allow the customization of diagrams for this project. Besides, the drag-and-drop interfaces and pre-built templates also make it easier to create diagrams in the shortest time.

3.3.3   Frontend Development

For frontend development, the React.js framework is used because it is built around reusable components. By using React.js, code can be supported, and this makes it easier to manage and update code in the future. Additionally, ReactStrap, a responsive CSS framework, is also being used in conjunction with React.js for designation to ensure an adaptive layout across the web application. This is because ReactStrap are able to provide pre-built components like buttons, navigation bars, and modals. This speeds up development and also helps maintain a clean and consistent design across the web application.

3.3.4   Backend Development

The backend of the project is developed using Laravel. It is a well-known PHP framework for web development because of its clean structure and well-organized code. Another key reason for choosing Laravel is because it is able to serve as the bridge between the frontend and backend by managing the RESTful API to facilitate and ensure smooth communication. Apart from that, it handles user authentication, route management, and interaction with the database. Composer is used to manage external libraries and dependencies in order to keep the project's architecture and maintainability.

3.3.5   AI-Powered Study Plan Timetable Development

To develop an AI-generated study plan timetable for this project, the Large Language Models (LLMs) and LangChain framework are used. In this implementation, the open-source AI models Llama and Qwen are used to generate a personalized study plan, respectively, based on learner academic performance as it is efficient in generating human-like text responses. Besides, LangChain, which serves as a framework to build web applications with LLMs, is able to provide the tools for prompt engineering, memory handling, and structured output parsing.

3.3.6   Database Management and Local Deployment

MySQL has been selected as the primary database management system in this project to handle large amounts of data. It manages and stores data by ensuring a smooth data retrieval process. In this case, WampServer is used as the local development environment to facilitate database management. Together with it, phpMyAdmin is used as the web-based interface for managing MySQL databases by providing a simple method of managing database tables, executing queries, and performing database operations without requiring complicated command-line commands.

3.3.7   Development and Testing Tools

Visual Studio Code serves as the primary code editor used to write, debug, and test the Laravel and React codebase. VS Code comes with built-in tools and

extensions that are able to improve code quality and speed up development. Besides, GitLab, which offers issue tracking and project management features is used in this project for version control purposes to manage source code. This is to ensure that the code is organized and easy to manage from time to time. Additionally, Postman is testing and debugging RESTful API tools used during backend development to ensure smooth data exchange between frontend and backend. Using Postman can eliminate the need to write source code to test API by directly using Postman's interface to send requests and see the responses immediately. It is useful for testing different scenarios while ensuring that data flows between different modules of the system are correct.

3.4 Work Breakdown Structure

1.0 Planning

    1.1 Background Study of the Problem

    1.2 Identify Problem Statements

    1.3 Identify Project Objectives and Goals

    1.4 Propose Project Scope

    1.5 Propose Project Solution

    1.6 Propose Project Approach

    1.7 Identify Project Limitations

    1.8 Identify Target Users

    1.9 Determine Features Covered

    1.10 Select Project Development Tools

    1.11 Select Project Development Framework

    1.12 Design Work Breakdown Structure and Gantt Chart

2.0 Analysis

    2.1 Conduct Literature Review

        2.1.1 Literature Review on E-learning

        2.1.2 Literature Review on Gamification

        2.1.3 Literature Review on Personalization Learning

        2.1.4 Study on Existing E-learning Platforms

        2.1.5 Research on Software Development Methodology

    2.2 Conduct User Research

        2.2.1 Design Questionnaire

4.3.5 Post Assignments and Announcements

4.3.6 Participate in Forums and Interact with Students

4.3.7 Receive Notifications

4.4 Implementation of Additional Features

4.4.1 Integrate AI Study Plan Timetable Generator

4.4.2 Implement Personalized Dashboard for Students

4.5 Conduct Unit Testing

4.5.1 Frontend Unit Testing

4.5.2 Backend Unit Testing

4.5.3 API Testing with Postman

4.6 Integrate All Modules

4.7 Conduct System Testing

4.8 Conduct User Acceptance Testing

4.8.1 Prepare Test Cases

4.8.2 Collect User Feedback

4.8.3 Resolve Reported Issues

5.0 Deployment

5.1 Deploy Web Application to Amazon Elastic Compute Cloud (EC2)

5.2 Deploy Database to Amazon Relational Database Service (RDS)

5.3 Final System Testing in a Live Environment

6.0 Project Closure

6.1 Prepare Project Poster

6.2 Prepare Final Project Report

3.5   Gantt Chart

	WBS	Task Name	Duration	Start	Finish	Cost
1	1.0	**Planning**	13 days	Mon 10/2/25	Wed 26/2/25	RM0.00
2	1.1	Background Study of The Problem	4 days	Mon 10/2/25	Thu 13/2/25	RM0.00
3	1.2	Identify Problem Statements	2 days	Fri 14/2/25	Sat 15/2/25	RM0.00
4	1.3	Identify Project Objectives and Goals	2 days	Sun 16/2/25	Mon 17/2/25	RM0.00
5	1.4	Propose Project Scope	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
6	1.5	Propose Project Solution	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
7	1.6	Propose Project Approach	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
8	1.7	Identify Project Limitations	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
9	1.8	Identify Target Users	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
10	1.9	Determine Features Covered	5 days	Tue 18/2/25	Sat 22/2/25	RM0.00
11	1.10	Select Project Development Tools	2 days	Sun 23/2/25	Mon 24/2/25	RM0.00
12	1.11	Select Project Development Framework	2 days	Sun 23/2/25	Mon 24/2/25	RM0.00
13	1.12	Design Work Breakdown Structure	2 days	Tue 25/2/25	Wed 26/2/25	RM0.00
14	1.13	Design Gantt Chart	2 days	Tue 25/2/25	Wed 26/2/25	RM0.00
15	2.0	**Analysis**	34 days	Thu 27/2/25	Tue 15/4/25	RM0.00
16	2.1	Conduct Literature Review	14 days	Thu 27/2/25	Tue 18/3/25	RM0.00
17	2.1.1	Literature Review on E-learning	3 days	Thu 27/2/25	Sun 2/3/25	RM0.00
18	2.1.2	Literature Review on Gamification	3 days	Tue 4/3/25	Thu 6/3/25	RM0.00
19	2.1.3	Literature Review on Personalization Learning	3 days	Fri 7/3/25	Tue 11/3/25	RM0.00
20	2.1.4	Study on Existing E-learning Platforms	4 days	Wed 12/2/25	Sat 15/2/25	RM0.00
21	2.1.5	Research on Software Development Methodology	3 days	Sun 16/3/25	Tue 18/3/25	RM0.00
22	2.2	Conduct User Research	14 days	Wed 19/3/25	Sat 5/4/25	RM0.00
23	2.2.1	Design Questionnaire	3 days	Wed 19/3/25	Fri 21/3/25	RM0.00
24	2.2.2	Distribute Questionnaire to Target Users	10 days	Sat 22/3/25	Thu 3/4/25	RM0.00
25	22.3	Analyse Questionnaire Responses	2 days	Fri 4/4/25	Sat 5/4/25	RM0.00
26	2.3	Identify Functional and Non-Functional Requirements	3 days	Sun 6/4/25	Tue 8/4/25	RM0.00
27	2.4	Design Use Case Diagram	45 days	Sun 9/2/25	Thu 10/4/25	RM0.00
28	2.5	Create Use Case Description	3 days	Fri 11/4/25	Tue 15/4/25	RM0.00

Figure 3.2: Project Gantt Chart.

	WBS	Task Name	Duration	Start	Finish	Cost
29	3.0	**Design**	22 days	Wed 16/4/25	Thu 15/5/25	RM0.00
30	3.1	Design Preliminary User Interface	11 days	Wed 16/4/25	Wed 30/4/25	RM0.00
31	3.2	Design System Architecture	3 days	Thu 1/5/25	Sun 4/5/25	RM0.00
32	3.3	Design Entity-Relationship Diagram (ERD)	4 days	Mon 5/5/25	Thu 8/5/25	RM0.00
33	3.4	Design Data Dictionary	2 days	Thu 8/5/25	Fri 9/5/25	RM0.00
34	3.5	Design Data Flow Diagram (DFD)	2 days	Sat 10/5/25	Sun 11/5/25	RM0.00
35	3.6	Design API Endpoints	4 days	Mon 12/5/25	Thu 15/5/25	RM0.00
36	4.0	**Implementation and Testing**	65 days	Fri 16/5/25	Thu 14/8/25	RM0.00
37	4.1	Implementation of Student Module	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
38	4.1.1	Manage Student Profiles and Enrol In Courses	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
39	4.1.2	Access Learning Materials	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
40	4.1.3	Participate in Questions, Quizzes, and Assessments	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
41	4.1.4	Participate in Forums and Receive Personalized Feedback	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
42	4.1.5	View Assessment Deadlines	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
43	4.1.6	Earn Badges and Climb Leaderboards	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
44	4.1.7	View History of Completion and Track Progress	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
45	4.1.8	Receive Notifications	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
46	4.2	Implementation of Admin Module	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
47	4.2.1	Manage Teacher and Student Accounts	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
48	4.2.2	Approve or Remove Learning Materials and Questions	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
49	4.2.3	Verify Teachers' Status	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
50	4.2.4	Assign Teachers to Courses	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
51	4.2.5	Implement Audit Logs	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
52	4.2.6	Receive Notifications	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
53	4.3	Implementation of Teacher Module	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
54	4.3.1	Manage Teacher Profiles	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
55	4.3.2	Upload Course Materials	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
56	4.3.3	Create and Manage Questions, Quizzes, and Assignments	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00

Figure 3.3: Project Gantt Chart.

|	WBS	Task Name	Duration	Start	Finish	Cost
57	4.3.4	Track Student Progress and Generate Reports	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
58	4.3.5	Post Assignments and Announcements	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
59	4.3.6	Participate in Forums and Interact with Students	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
60	4.3.7	Receive Notifications	32 days	Fri 16/5/25	Sat 28/6/25	RM0.00
61	4.4	Implementation of Additional Features	12 days	Sun 29/6/25	Mon 14/7/25	RM0.00
62	4.4.1	Integrate AI Study Plan Timetable Generator	11 days	Sun 29/6/25	Fri 11/7/25	RM0.00
63	4.4.2	Implement Personalized Dashboard for Students	2 days	Sat 12/7/25	Mon 14/7/25	RM0.00
64	4.5	Conduct Unit Testing	7 days	Tue 15/7/25	Wed 23/7/25	RM0.00
65	4.5.1	Frontend Unit Testing	3 days	Tue 15/7/25	Thu 17/7/25	RM0.00
66	4.5.2	Backend Unit Testing	2 days	Fri 18/7/25	Sun 20/7/25	RM0.00
67	4.5.3	API Testing with Postman	3 days	Mon 21/7/25	Wed 23/7/25	RM0.00
68	4.6	Integrate All Modules	3 days	Thu 24/7/25	Sun 27/7/25	RM0.00
69	4.7	Conduct System Testing	4 days	Mon 28/7/25	Thu 31/7/25	RM0.00
70	4.8	Conduct User Acceptance Testing	10 days	Fri 1/8/25	Thu 14/8/25	RM0.00
71	4.8.1	Prepare Test Cases	2 days	Fri 1/8/25	Sun 3/8/25	RM0.00
72	4.8.2	Collect User Feedback	6 days	Mon 4/8/25	Mon 11/8/25	RM0.00
73	4.8.3	Resolve Reported Issues	3 days	Tue 12/8/25	Thu 14/8/25	RM0.00
74	**5.0**	**Deployment**	**6 days**	**Fri 15/8/25**	**Fri 22/8/25**	**RM0.00**
75	5.1	Deploy Web Application to Amazon Elastic Compute Cloud (EC2)	2 days	Fri 15/8/25	Sun 17/8/25	RM0.00
76	5.2	Deploy Database to Amazon Relational Database Service (RDS)	2 days	Mon 18/8/25	Tue 19/8/25	RM0.00
77	5.3	Final System Testing in a Live Environment	3 days	Wed 20/8/25	Fri 22/8/25	RM0.00
78	**6.0**	**Project Closure**	**20 days**	**Sat 23/8/25**	**Thu 18/9/25**	**RM0.00**
79	6.1	Prepare Project Poster	3 days	Sat 23/8/25	Tue 26/8/25	RM0.00
80	6.2	Prepare Final Project Report	14 days	Sat 23/8/25	Wed 10/9/25	RM0.00
81	6.3	Prepare Presentation Slides	6 days	Thu 11/9/25	Thu 18/9/25	RM0.00

Figure 3.4: Project Gantt Chart.

CHAPTER 4

PROJECT SPECIFICATION

4.1   Introduction

This chapter reviews the questionnaire evaluation across five sections, including general information, academic performance and motivation, learning preferences and online learning experiences, study plan timetable, and gamification. The project requirements are listed in detail by including both functional and functional requirements together with the project assumptions, followed by the use case diagram and use case description.

4.2   Questionnaire Evaluation

A questionnaire was distributed via Google Forms and a total of 40 responses were collected. The evaluation of the questionnaire covers the following sections:

4.2.1   General Information
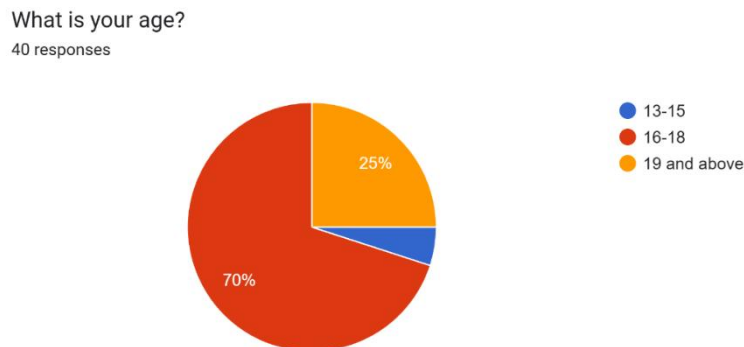
Figure 4.1: Age Distribution.

The majority of the respondents fall within the typical secondary school or pre-university age range. Based on the figure, 5% of the respondents are between 13 and 15 years old, 70% are between 16 and 18 years old, while the remaining 25% are 19 years old and above. This indicates that most participants are

studying in secondary school or have recently completed their secondary education.

What is your current education level?
40 responses
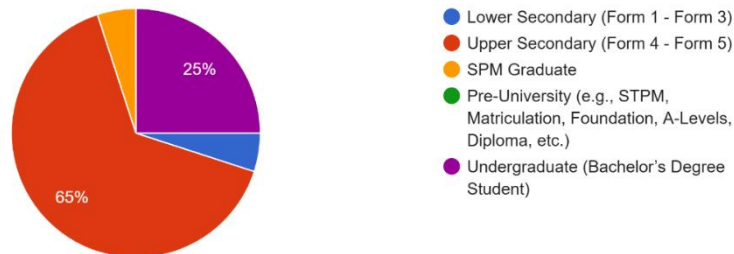
Figure 4.2: Current Education Level Distribution.

The results show that the majority of respondents (65%) are in the upper secondary level, including Form 4 and Form 5 students preparing for the SPM examination. 25% of the respondents are undergraduates who have recently completed SPM and continued tertiary education. Besides, a small portion of respondents (5%) are from the lower secondary level while the remaining 5% are SPM graduates who have completed their secondary education.

Do you have access to the Internet?
40 responses
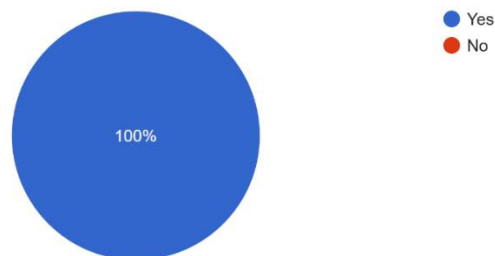
Figure 4.3: Internet Accessibility Distribution.

All respondents (100%) have access to the Internet. This suggests that the target users have the necessary connectivity to use a web-based e-learning platform.

What device(s) do you own?
40 responses
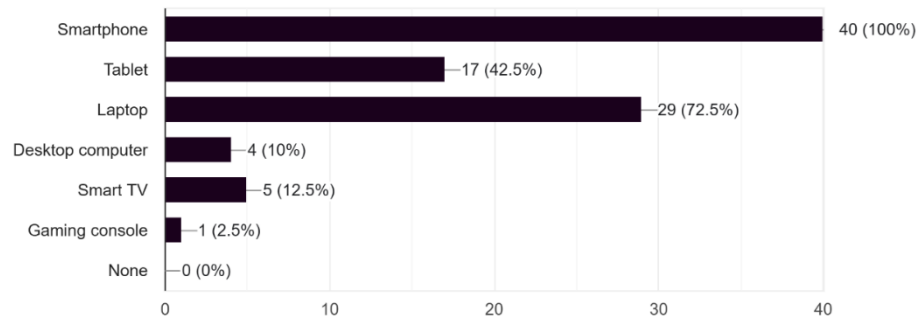
Figure 4.4: Device Ownership Distribution.

All of the respondents (100%) own a smartphone, and 72.5% of them own a laptop. Additionally, 42.5% of the respondents own a tablet, and there is also a smaller portion of respondents (10%) who own a desktop computer. However, only 2.5% of the respondents own a gaming console.

Do you have any special learning needs (e.g., Dyslexia, ADHD)?
40 responses
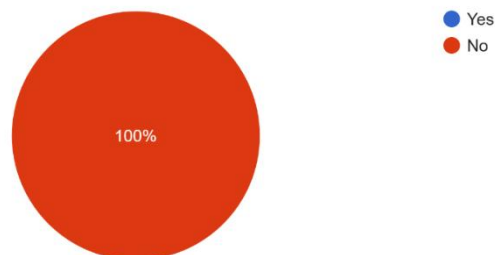
Figure 4.5: Special Learning Needs Distribution.

The result shows that there are no special learning needs such as Dyslexia or ADHD. This means that there are no alternative learning strategies to be accommodated. Thus, a standard learning process and environment can be proceeded in the web-based e-learning platform.

4.2.2   Academic Performance and Motivation

This section is to understand the academic performance of the respondents and their motivation towards study.

How many A's did you obtain or expect to obtain in SPM?
40 responses
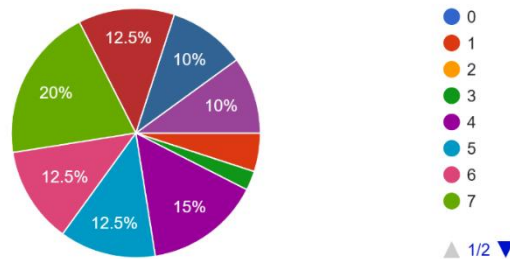
Figure 4.6: Number of A's Obtained or Expected in SPM Distribution.

The distribution of the number of A's obtained or expected by the respondents in SPM is as follows: 2.5% for 3 A's, 5% for 1 A, 10% for 10 A's, 10% for 9 A's, 12.5% for 8 A's, 20% for 7 A's, 12.5% for 6 A's, 12.5% for 5 A's, and 15% for 4 A's.

On a scale of 1-5, how motivated are you to study?
40 responses
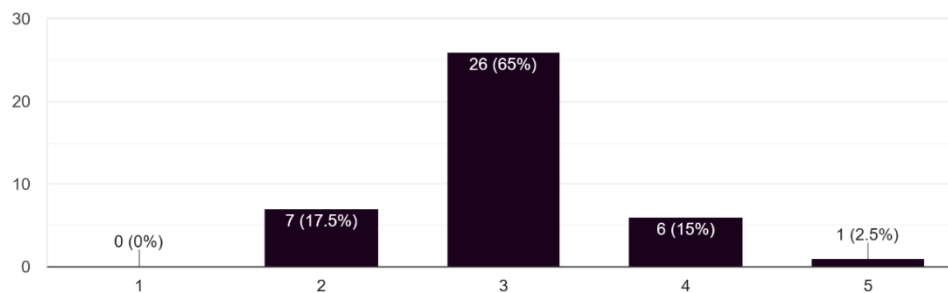
Figure 4.7: Motivation Level Analysis.

The majority of respondents (65%) reported a moderate level of motivation (scale 3) in their studies. A smaller portion (15%) felt motivated (scale 4), while 17.5% rated their motivation as low (scale 2), and only 2.5% rated it at the highest level (scale 5). None of the respondents chose scale 1 and this indicates

that no one felt completely unmotivated. Overall, the results show that most students have a fair level of motivation to study.

4.2.3 Learning Preferences and Online Learning Experiences

This section is to study the respondents learning preferences and online learning experiences by examining their daily study time, preferred learning method, usage of online learning platforms, and experiences faced during online learning.
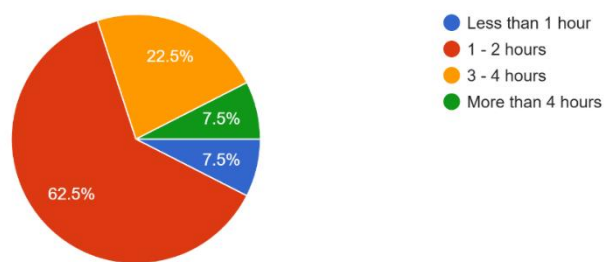
Figure 4.8: Daily Study Time Distribution.

The majority of respondents (62.5%) typically spend 1-2 hours per day studying. There is another portion (22.5%) that studies for 3-4 hours daily, while smaller groups spend less than 1 hour (7.5%) or more than 4 hours (7.5%) per day. This suggests that while most respondents have a moderate study routine.
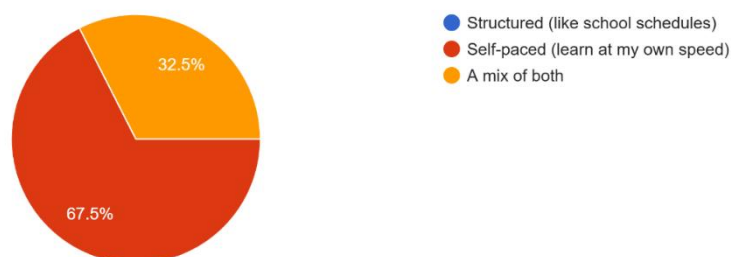
Figure 4.9: Preference for Structured vs. Self-Paced Learning Distribution.

The majority of respondents (67.5%) prefer a mix of both structured lessons and self-paced learning. A smaller portion (32.5%) prefer self-paced learning, where they can learn at their own speed, while none of the respondents preferred structured lessons alone.
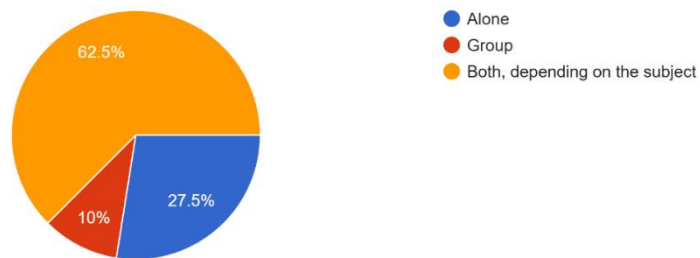
Figure 4.10:   Preference for Studying Alone vs. in a Group Distribution.

The majority of respondents (62.5%) prefer studying both alone and in a group, depending on the subject. A smaller portion (27.5%) prefer studying alone, while 10% prefer group study. This suggests that students can benefit from both individual and collaborative study by adapting to different approaches based on the specific needs of the subject matter.
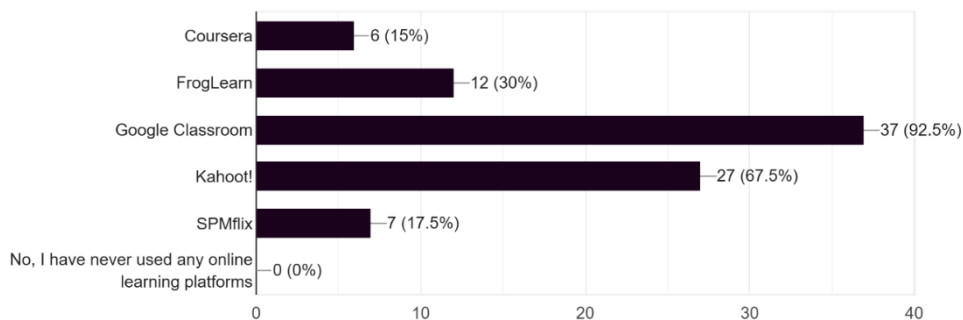
Figure 4.11:   Usage of Online Learning Platforms Distribution.

The majority of respondents (92.5%) have used Google Classroom, while Kahoot! follows with 67.5%. Besides, FrogLearn has been used by 30% of respondents while SPMflix and Coursera are used by 17.5% and 15% of respondents respectively. Additionally, none of the respondents reported never using any online learning platforms. This shows that online platforms are widely adopted for secondary education.
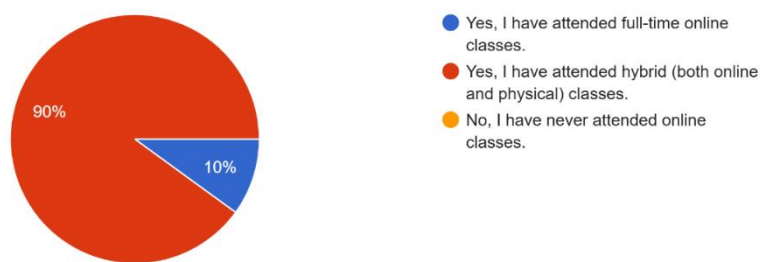
Figure 4.12:   Experience with Online Classes Distribution.

The majority of respondents (90%) are familiar with hybrid learning and have experienced both online and physical classes. There is also a smaller portion of respondents (10%) that has attended full-time online classes.
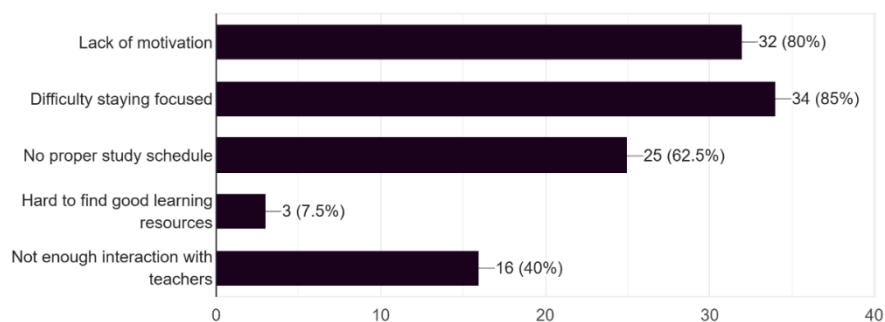
Figure 4.13:   Challenges Faced During Online Learning Distribution.

The challenges faced by respondents when studying online are the lack of motivation (80%), difficulty staying focused (85%), and not having a proper study schedule (62.5%). Additionally, 40% of respondents claimed that there is not enough interaction with teachers, and a smaller portion (7.5%) expressed the difficulty in finding good learning resources.

4.2.4   Study Plan Timetable

This section is to examine whether the respondents have a study plan timetable and to explore their interest in an AI-generated personalized study plan timetable.

Do you have a study plan?
40 responses

- Yes
- No

52.5%

47.5%
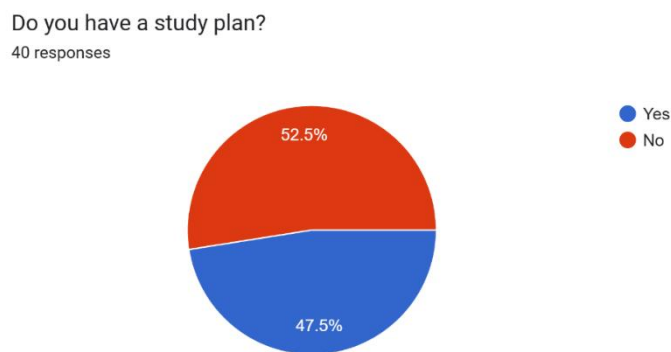
Figure 4.14:   Having a Study Plan Timetable Distribution.

The results show that more than half of the respondents (52.5%) have a study plan while the remaining 47.5% do not have one.

Would you be interested in an AI-generated personalized study plan for your learning?
40 responses

- Yes
- No
- Maybe

17.5%

82.5%
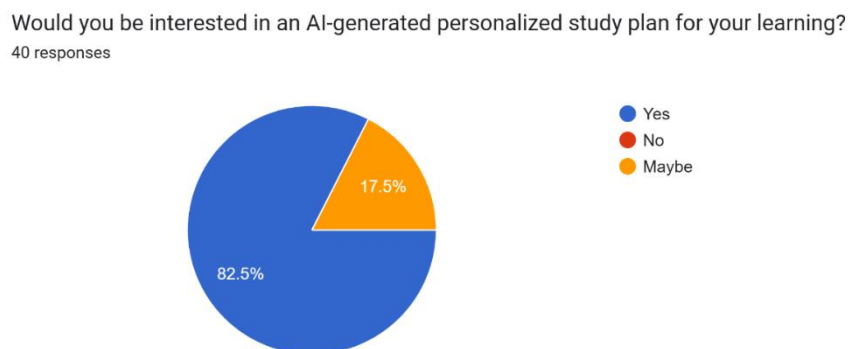
Figure 4.15:   Interest in AI-Generated Personalized Study Plan Timetable Distribution.

The majority of respondents (82.5%) showed their interest in an AI-generated personalized study plan while a smaller portion (17.5%) showed some uncertainty. These results show an openness toward an AI-generated study plan timetable.

4.2.5 Gamification

This section is to explore respondents attitudes and interest towards a gamified e-learning platform and preferred gaming elements in the study.
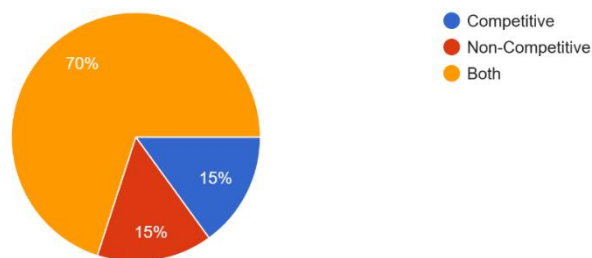
Figure 4.16:   Preference for Competitive vs. Non-Competitive
Gamification Distribution.

The majority of respondents (70%) preferred both competitive and non-competitive gamification. However, 15% of the respondents preferred competitive gamification while another 15% preferred non-competitive gamification. The results show that most of the students are open to both learning styles.

Would you be more motivated to study if learning felt like a game?
40 responses
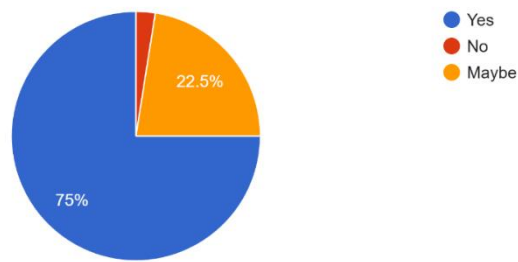
Figure 4.17:   Motivation of Study if Learning Felt Like a Game
Distribution.

The majority of respondents (75%) indicated that they would feel more motivated to study if learning felt like a game. However, 22.5% responded with "maybe" and only 2.5% disagreed with it. This reflects a positive attitude towards gamification in increasing study motivation.

Which gamification elements do you like the most?
40 responses
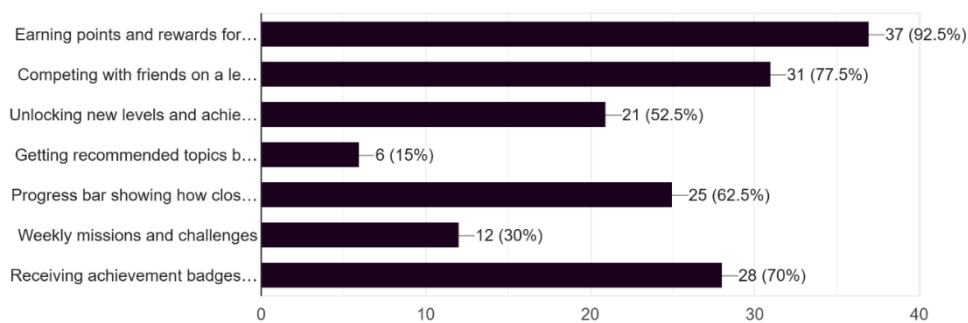
Figure 4.18:   Preferred Gamification Elements Distribution.

The most popular gamification element is the earning of points and rewards, with 92.5% of respondents. The second is to compete with friends on a leaderboard by 77.5%. Besides, 70% of respondents would like to receive achievement badges for recognition of progress. The progress bar showing how close they are to the next level was preferred by 63.5% of respondents while 52.5% preferred unlocking new levels and achievements. There are also 30% of

respondents who like to have weekly missions and challenges, whereas only 15% appreciated receiving recommended topics based on progress.

Would you be interested in trying a gamified e-learning website for your studies?
40 responses
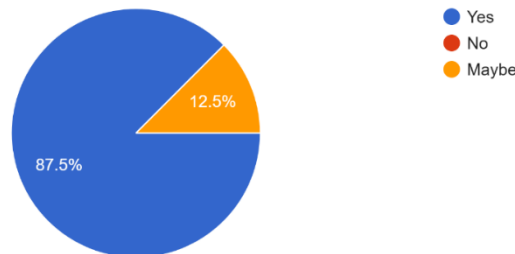
Figure 4.19:   Gamified E-Learning Interest Distribution.

87.5% of the respondents are interested in trying gamified e-learning websites for their studies. A smaller group (12.5%) of the respondents showed hesitation or uncertainty, but none of the respondents rejected the idea. This suggests that there is a positive attitude toward a gamified e-learning platform.

4.2.6   Findings of Questionnaire Responses

The finding shows that the majority of respondents are familiar with online learning platforms and hybrid learning. Besides, there is a strong interest in the AI-generated personalized study plan timetable and gamified e-learning experience among the students. Most of the respondents are open to both competitive and non-competitive gamification and prefer a mix of structured and self-paced learning. Additionally, the majority of respondents are motivated to study with gaming elements like earning points, competing with friends, and receiving achievement badges.

4.3 Functional Requirements

4.3.1 All Modules

Table 4.1: Functional Requirements for All Modules.

ID	Requirement
FR001	The web application shall allow users to register for an account.
FR002	The web application shall allow users to log in with email and password.
FR003	The web application shall allow users to manage their profiles.
FR004	The web application shall allow users to receive notifications.
FR005	The web application shall allow users to view the dashboard.
FR006	The web application shall allow users to manage support and inquiries.

4.3.2 Student Module

Table 4.2: Functional Requirements for Student Module.

ID	Requirement
FR007	The web application shall allow students to enroll in courses.
FR008	The web application shall allow students to access learning materials.
FR009	The web application shall allow students to participate in quizzes and assignment questions.
FR010	The web application shall allow students to view quizzes and assignment deadlines.
FR011	The web application shall allow students to participate in forums and discussions.
FR012	The web application shall allow students to receive personalized feedback from teachers.
FR013	The web application shall allow students to track their completion history and progress.

FR014	The web application shall allow students to generate a personalized AI study plan timetable.
FR015	The web application shall allow students to set a to-do list.
FR016	The web application shall allow students to earn points, rewards, and badges.
FR017	The web application shall allow students to climb leaderboards.
FR018	The web application shall allow students to participate in daily missions and challenges.

4.3.3   Teacher Module

Table 4.3:   Functional Requirements for Teacher Module.

ID	Requirement
FR019	The web application shall allow teachers to manage course content and teaching materials.
FR020	The web application shall allow teachers to manage quizzes and assignment questions with deadlines.
FR021	The web application shall allow teachers to provide personalized feedback to students.
FR022	The web application shall allow teachers to track student progress in the course.
FR023	The web application shall allow teachers to participate in forums and discussions.

4.3.4   Admin Module

Table 4.4:   Functional Requirements for Admin Module.

ID	Requirement
FR019	The web application shall allow admins to manage user accounts.
FR020	The web application shall allow admins to verify the status of teachers.

FR021	The web application shall allow admins to manage teachers and students in courses.
FR022	The web application shall allow admins to manage courses and learning materials.
FR023	The web application shall allow admins to manage gamification elements.
FR024	The web application shall allow admins to view audit logs.

4.4 Non-Functional Requirements

Table 4.5: Non-Functional Requirements.

ID	Requirement	Category
NFR001	The web application shall load each page within 3 seconds under normal conditions.	Performance
NFR002	The web application shall process user queries generated by AI and deliver responses within 1 minute of the query being submitted.	Performance
NFR003	The web application shall be available 99.5% of the time during operation hours.	Availability
NFR004	The web application shall implement role-based access control (RBAC) to restrict access to administrative and teaching functionalities based on user roles.	Security
NFR005	The web application shall secure user authentication with encrypted passwords using industry-standard encryption algorithms such as bcrypt.	Security
NFR006	The web application shall verify the email during user registration to ensure the validity of the provided email.	Security
NFR007	The web application shall not take more than 30 minutes of training for new users.	Usability

NFR008	The web application shall achieve a minimum System Usability Scale score of 80 out of 100 from user testing sessions.	Usability
NFR009	The web application shall be developed using modular code for ease of maintenance and modification.	Maintainability
NFR010	The web application shall be compatible with major web browsers which including Chrome, Firefox, and Edge.	Portability

4.5   Use Case

4.5.1   Use Case Diagram
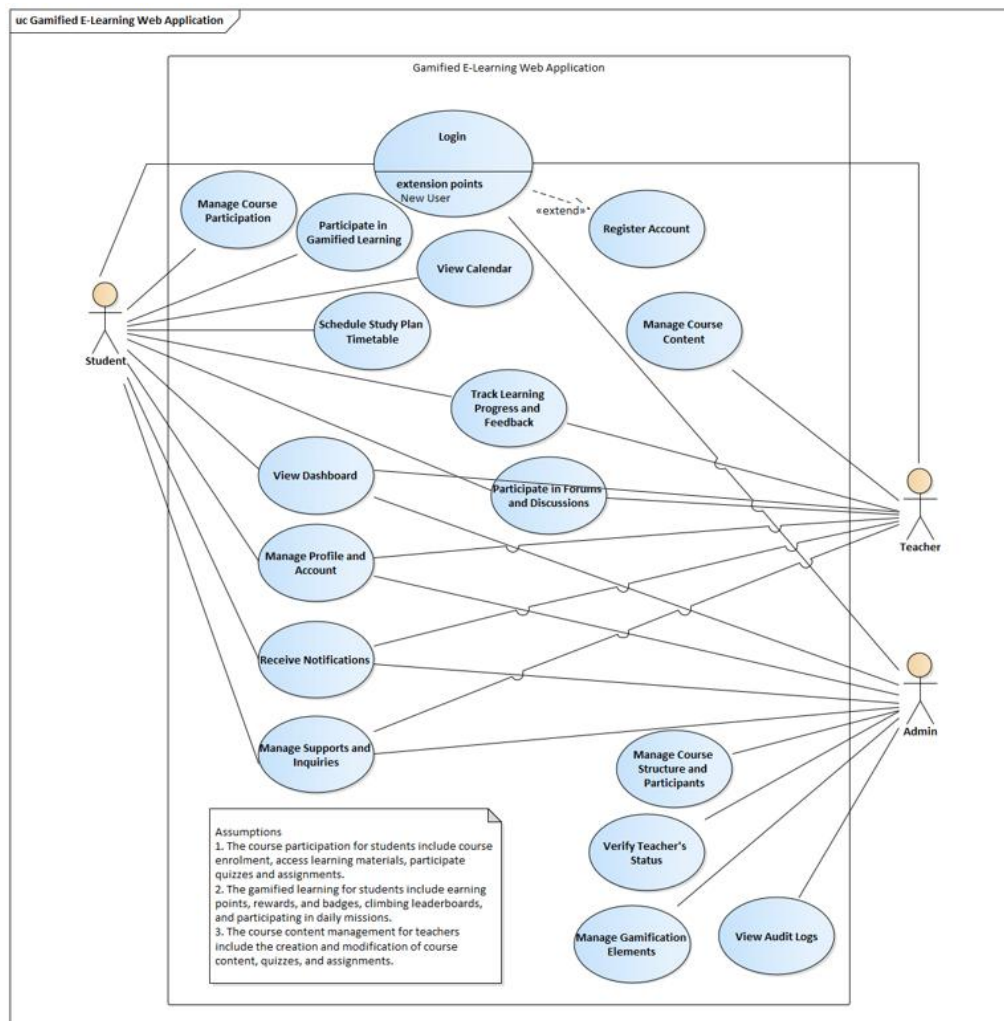
Figure 4.20:   Use Case Diagram of Gamified E-Learning Web Application.

4.5.2   Use Case Description

Table 4.6:   Use Case Description of Login.

Use Case Name: Login	ID: UC001	Importance Level: High
Primary Actor: Student, Teacher, Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of logging into the web application with the user's credentials to access authorized features and data.		
Trigger: The user with an account initiates a login request by submitting their credentials.		
Relationships: Association: Student. Teacher, Admin Extend: Register Account		
Normal Flow of Events: 1. The user enters the email and password. 2. The user clicks on the login button. 3. The web application validates the credentials. Continue to SubFlows – Perform 3.1 or 3.2.		
SubFlows: 3.1 If the email and password are correct: 3.1.1 The user is redirected to their respective dashboard. 3.1.2 The login process is completed successfully. 3.2 If the email and password are incorrect,: 3.2.1 The web application displays an error message. 3.2.2 Return to Step 1 of the Normal Flow to retry login.		
Alternate/Exceptional Flows: N/A		

Table 4.7:   Use Case Description of Register Account.

Use Case Name: Register Account	ID: UC002	Importance Level: High
Primary Actor: Student, Teacher	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of registering an account by providing the required personal details and verifying identity through a confirmation email for a new user.		
Trigger: The user clicks on the register button from the login page.		
Relationships: Association: Student, Teacher		
Normal Flow of Events: 1. The user clicks on the register button at the login page. 2. The user enters their full name, username, email address, password, and confirm password. 3. The user selects either student or teacher by ticking the appropriate checkbox. 4. The user clicks on the register button. 5. The web application validates the entered data. Continue to SubFlows – Perform 5.1 or 5.2.		
SubFlows: 5.1 If all data is valid: 5.1.1 The web application creates a new user account and sends a verification email. 5.1.2 The web application displays a message. 5.1.3 The user verifies their identity in the confirmation email. 5.1.4 The web application confirms the email and activates the user account. 5.1.5 The user is redirected to the login page. 5.2 If the data entered is not valid:		

5.2.1 The web application displays an error message. 5.2.2 The user remains on the registration page and returns to Step 2 of Normal Flow to retry registration.
Alternate/Exceptional Flows: N/A

Table 4.8: Use Case Description of View Dashboard.

Use Case Name: View Dashboard	ID: UC003	Importance Level: High
Primary Actor: Student, Teacher, Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the processing of accessing personalized dashboard.		
Trigger: The user has successfully login to the web application or clicks on the "View Dashboard" from the navigation menu.		
Relationships: Association: Student, Teacher, Admin		
Normal Flow of Events: 1. The user logs in successfully or clicks on the "View Dashboard" from the navigation menu. 2. The web application checks the user's role and displays the appropriate dashboard. 3. The user views the content from the dashboard.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

Table 4.9:   Use Case Description of Manage Profile and Account.

Use Case Name: Manage Profile and Account	ID: UC004	Importance Level: Medium
Primary Actor: Student, Teacher, Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of managing profile and account while teacher can submit certification. The admin has additional privileges to manage profiles and accounts for students and teachers.		
Trigger: The student and teacher click on their profile icons or selects "User Profile" from the navigation menu. The admin select "All Users" from the navigation menu.		
Relationships: Association: Student, Teacher, Admin		
Normal Flow of Events: Student/ Teacher 1. The user clicks on the profile icon or select "User Profile" from the navigation menu. 2. The user is directed to the user profile page. Continue to SubFlows – Perform 2.1 or 2.2. Admin 1. The admin select "All Users" from the navigation menu. 2. The admin is directed to all users page. 3. The admin selects to search for students or teacher by name. Continue to SubFlows – Perform 3.1, 3.2, or 3.3.		

SubFlows:
 Student/ Teacher
 2.1 If the user wants to update the profile information:
   2.1.1 The user clicks on the edit icon on the profile page
   2.1.2.The user selects the field to be updated.
   2.1.3. The user enters new information		

2.1.4. The user clicks on the update button.

2.1.5. The web application prompts the user to enter password for identity verification.

2.1.6. If the password is correct, the web application ask the user to confirm the update.

2.1.7. Upon confirmation, the profile is updated and a message is displayed.

2.2 If the user wants to delete the account:

2.2.1. The user clicks on the profile icon or select "User Profile" from the navigation menu.

2.2.2. The user clicks on the delete button.

2.2.3.The web application prompts to enter password for verification identity

2.2.4. If the password is correct, the web application asks the user to confirm the deletion.

2.2.5. Upon confirmation, the account is deleted and the user is redirected to the login page.

Admin

3.1 If the admin wants to update the user's profile information:

3.1.1 The user clicks on the edit icon on the profile page

3.1.2.The user selects the field to be updated.

3.1.3. The user enters new information

3.2 If the admin wants to delete a user's account:

3.2.1. The admin clicks on the delete button.

3.2.2. The web application asks the admin to confirm the deletion.

3.2.3. Upon confirmation, the account is deleted and a message is displayed.

3.3 If the admin wants to delete course enrolled or assigned to a user:

3.3.1 The admin clicks on the delete icon

3.3.2 The web application asks the admin to confirm the deletion.

3.2.3. Upon confirmation, the course is deleted for the user and a message is displayed.

Alternate/Exceptional Flows: N/A

Table 4.10: Use Case Description of Receive Notifications.

Use Case Name: Receive Notifications	ID: UC005	Importance Level: Medium
Primary Actor: Student, Teacher, Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of receiving and viewing the notifications.		
Trigger: The user clicks on the notification icon located in the header section.		
Relationships: Association: Student, Teacher, Admin		
Normal Flow of Events: 1. The user can click on the notification bell icon located in the header section. 2. The web application checks the user's notification preferences. Continue to SubFlows – Perform 2.1 or 2.2.		

SubFlows:
 2.1 If the notifications are turned off:
     2.1.1 The user does not receive any notifications.
 2.2 If the notifications are turned on and there are new notifications:
     2.2.1 The web application displays a number indicating the count of unread notifications.
     2.2.2 The user clicks on the number to view the list of notifications.
     2.2.3 The user can click on an individual notification to view more details by being redirected to the relevant section.		

Alternate/Exceptional Flows: N/A		

Table 4.11: Use Case Description of Manage Supports and Inquiries.

Use Case Name: Manage Supports and Inquiries	ID: UC006	Importance Level: Medium
Primary Actor: Student, Teacher, Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of viewing FAQs and submitting inquiries by students and teachers, and managing, responding, and updating the status of inquiries by the admin.		
Trigger: The user selects "FAQs/ Inquiries" from the navigation menu.		
Relationships: Association: Student, Teacher, Admin		
Normal Flow of Events: Student/ Teacher 1. The user selects "FAQs/ Inquiries" from the navigation menu. 2. The web application displays a list of frequently asked questions (FAQs). 3. The user can scroll down to the submit inquiry section. 4. The user enters their email address, selects an inquiry category, and provides a description. 5. The user clicks on the submit button. 6. The web application displays a confirmation message. Admin 1. The admin selects "FAQs/ Inquiries" from the navigation menu. 2. The web application displays a list of all submitted inquiries. 3. The admin can filter inquiries by status. 4. The admin updates the status and fills in action taken for each inquiry.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

Table 4.12: Use Case Description of Manage Course Participation.

Use Case Name: Manage Course Participation	ID: UC007	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of participating in a course for viewing announcements, accessing course-related materials, participating in quizzes, and submitting assignments.		
Trigger: The student selects "Courses" from the navigation menu.		
Relationships: Association: Student		
Normal Flow of Events: 1. The student selects "Courses" from the navigation menu. 2. The web application displays a list of available courses. 3. The student clicks on the join button to enrol in the course. Continue to SubFlows – Perform 3.1, 3.2, 3.3, or 3.4.		
SubFlows: 3.1 If the student wants to see the announcement for the course: 3.1.1 The student clicks on the announcement tab. 3.1.2 The web application displays a list of announcements. 3.2 If the student wants to access learning materials: 3.2.1 The student clicks on the notes tab. 3.2.2 The web application displays a list of notes. 3.2.3 The student clicks on the download button. 3.2.3 Once it is downloaded, the web application displays a message. 3.3 If the student wants to participate in quizzes: 3.3.1 The student clicks on the quizzes tab. 3.3.2 The web application displays a list of quizzes with details. 3.3.3 The student clicks on the attempt button. 3.3.4 The student answers the quiz. 3.3.5 The answer and mark for each question are displayed.		

3.3.6 The student clicks on the close button after attempting the quiz.
 	
3.4 If the student wants to submit assignments:
 	
    3.4.1 The student clicks on the assignments tab.
 	
    3.4.2 The web application displays a list of assignments with details.
 	
    3.4.3 The student clicks on the submit button.
 	
    3.4.4 The student uploads the assignment to be submitted.
 	
    3.4.5 Upon confirmation, the web application displays a message confirming submission.	

Alternate/Exceptional Flows: N/A	

Table 4.13: Use Case Description of Participate in Gamified Learning.

Use Case Name: Participate in Gamified Learning	ID: UC008	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes how students interact with gamified features such as experience points (XP), coins, levels, badges, leaderboards, and missions.		
Trigger: The student interacts with any gamified learning features from the navigation menu or within the web application.		
Relationships: Association: Student		
Normal Flow of Events: 1. The student views the real-time updates of earned coins, experience points, and current level in the header section. 2. The student selects "Leader Board" from the navigation menu. 3. The student views the overall leaderboard rankings and their personal ranking. 4. The student navigates to the daily missions section.		

5. The student views a list of available daily tasks and tracks completed and remaining tasks.
6. The student selects "Badges" from the navigation menu.
7. The student views the earned badges and unlocked milestones.
SubFlows: N/A
Alternate/Exceptional Flows: N/A

Table 4.14: Use Case Description of Schedule Study Plan Timetable.

Use Case Name: Schedule Study Plan Timetable	ID: UC009	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of generating a study plan timetable and organizing academic tasks.		
Trigger: The student selects "Study Plan Timetable" from the navigation menu.		
Relationships: Association: Student		
Normal Flow of Events: 1. The student selects "Study Plan Timetable" from the navigation menu. 2. The student fills in the school schedule, subjects ranking, and available study time each day. 3. The student clicks on the generate button. 4. The web application processes the input and generates a personalized study plan timetable. 5. The student navigates to the to-do lists section. 6. The student fills in daily, weekly, and monthly to-do items.		
SubFlows: N/A		

Alternate/Exceptional Flows: N/A		

Table 4.15: Use Case Description of View Calendar.

Use Case Name: View Calendar	ID: UC010	Importance Level: Medium
Primary Actor: Student	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of accessing and viewing the calendar to check academic deadlines.		
Trigger: The student selects "View Calendar" from the navigation menu.		
Relationships: Association: Student		
Normal Flow of Events: 1. The student selects "View Calendar" from the navigation menu. 2. The student views deadlines for quizzes, assignments, and tests. 3. The student navigates through the calendar by switching between different months to view upcoming or past deadlines.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

Table 4.16: Use Case Description of Manage Course Content.

Use Case Name: Manage Course Content	ID: UC011	Importance Level: High
Primary Actor: Teacher	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of managing course content by adding, updating, deleting course announcements, teaching materials, quizzes, and assignments.		

Trigger: The teacher selects "Courses" from the navigation menu.

Relationships:

Association: Teacher

Normal Flow of Events:

1. The teacher selects "Courses" from the navigation menu.

2. The web application displays the courses assigned to the teacher. Perform 2.1, 2.2, 2.3, or 2.4.

> 2.1 If the teacher wants to manage the announcements: Continue to SubFlows – Perform 1, 2, or 3.
>
> 2.2 If the teacher wants to manage the teaching materials: Continue to SubFlows – Perform 1, 2, or 3.
>
> 2.3 If the teacher wants to manage the quizzes: Continue to SubFlows – Perform 1 or 3.
>
> 2.4 If the teacher wants to manage the assignments: Continue to SubFlows – Perform 1, 2, or 3.

3. Upon confirmation, the web application will display a message confirming the action.

SubFlows:

1. If the teacher wants to perform addition:

> 1.1 The teacher clicks on the add icon.
>
> 1.2 The teacher enters the required fields.
>
> 1.3 The teacher clicks on the post button.

2. If the teacher wants to perform updation:

> 2.1 The teacher clicks on the edit icon.
>
> 2.2 The teacher fills in new information.
>
> 2.3 The teacher clicks on the edit button.

3. If the teacher wants to perform deletion:

> 3.1 The teacher clicks on the delete icon.

Alternate/Exceptional Flows: N/A

Table 4.17: Use Case Description of Track Learning Progress and Feedback.

Use Case Name: Track Learning Progress and Feedback	ID: UC012	Importance Level: High
Primary Actor: Student, Teacher	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process		
Trigger: The student clicks on the histories tab under course enrolled while the teacher clicks on the student progress tab under course assigned.		
Relationships: Association: Student, Teacher		
Normal Flow of Events: Student 1. The student clicks on the student histories tab under the course enrolled. 2. The web application displays a list of attempted quizzes and assignments. 3. The student clicks on the view details button to view the results and feedback provided. Teacher 1. The teacher clicks on the student progress tab under the course assigned. 2. The web application displays a list of students in the course. 3. The teacher clicks on the eye icon to view each student's progress. 4. The web application displays the course history for the selected student. 5. The teacher clicks on the view details button for a specific quiz or assignment. 6. The teacher views the submission, provides feedback comments, and clicks on the submit button.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

Table 4.18: Use Case Description of Participate in Forums and Discussions.

Use Case Name: Participate in Forums and Discussions	ID: UC013	Importance Level: High
Primary Actor: Student, Teacher	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process for students and teachers to participate in forum discussions related to a specific course by viewing or joining forum topics and participating by posting replies.		
Trigger: The user clicks on the forums tab under the course enrolled in or assigned to.		
Relationships: Association: Student, Teacher		
Normal Flow of Events: Student/ Teacher 1. The user selects the forums tab under the course enrolled in or assigned to. 2. The web application displays a list of available forums. 3. The user clicks on the join or view details button. 4. The web application displays the message. 5. The user clicks on the reply button and types in the message to reply.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

Table 4.19: Use Case Description of Manage Course Structure and Participants.

Use Case Name: Manage Course Structure and Participants	ID: UC014	Importance Level: High
Primary Actor: Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process		

Trigger: The admin selects "Courses" from the navigation menu.

Relationships:

Association: Admin

Normal Flow of Events:

1. The admin selects "Courses" from the navigation menu.

2. The web application displays a list of all courses available.

3. The admin clicks on the course. Perform 3.1

> 3.1 If the admin wants to manage course announcements: Continue to SubFlows – Perform 1, 2, or 3.
>
> 3.2 If the admin wants to manage course materials: Continue to SubFlows – Perform 1, 2, or 3.
>
> 3.3 If the admin wants to manage quizzes: Continue to SubFlows – Perform 1 or 3.
>
> 3.4 If the admin wants to manage assignments: Continue to SubFlows – Perform 1, 2, or 3.
>
> 3.5 If the admin wants to manage discussion forums: Continue to SubFlows – Perform 2 or 3.
>
> 3.6 If the admin wants to manage the user lists:
>
> > 3.6.1 If the admin wants to assign a user to the course:
> >
> > > 3.6.1.1 The admin selects the user from the dropdown list and clicks on the assign button.
> > >
> > > 3.6.1.2 Upon confirmation, the web application displays a successful message.
> >
> > 3.6.2 If the admin wants to delete a user from the course:
> >
> > > 3.6.2.1 The admin selects the user and clicks on the delete icon.
> > >
> > > 3.6.2.2 Upon confirmation, the web application displays a successful message.

SubFlows:

1. If the admin wants to perform an addition:

> 1.1 The admin clicks on the add icon.

1.2 The admin enters the required fields. 1.3 The admin clicks on the post button. 2. If the teacher wants to perform updating: 2.1 The admin clicks on the edit icon. 2.2 The admin fills in new information. 2.3 The admin clicks on the edit button. 3. If the admin wants to perform a deletion: 3.1 The admin clicks on the delete icon.
Alternate/Exceptional Flows: N/A

Table 4.20: Use Case Description of Verify Teacher's Status.

Use Case Name: Verify Teacher's Status	ID: UC015	Importance Level: High
Primary Actor: Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of verifying teacher status through certification and the document submitted.		
Trigger: The admin selects "Status Verification" from the navigation menu.		
Relationships: Association: Admin		
Normal Flow of Events: 1. The admin selects "Status Verification" from the navigation menu. 2. The web application displays a list of teachers with pending status for verification. 3. The admin clicks on the document submitted for reviewing. 4. The admin updates the teacher's status through the drop-down list. 5. Upon confirmation, the web application will display a message.		
SubFlows: N/A		

Alternate/Exceptional Flows: N/A

Table 4.21: Use Case Description of Manage Gamification Elements.

Use Case Name: Manage Gamification Elements	ID: UC016	Importance Level: High
Primary Actor: Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of managing gamification settings which includes the experience levels, daily missions, leaderboards criteria, and achievement badges.		
Trigger: The admin selects "Gamification Management" from the navigation menu.		
Relationships: Association: Admin		
Normal Flow of Events: 1. The admin selects "Gamification Management" from the navigation menu. 2. The admin is directed to the gamification management page with five sections. Continue to SubFlows – Perform 2.1, 2.2, 2.3, 2.4, or 2.5. 3. Upon confirmation, the web application will display a message.		

SubFlows:
 2.1 If the admin wants to check the experience level mapping:
    2.1.1 The admin selects a level through a drop-down list.
 2.2 If the admin wants to configure the level setting:
    2.2.1 The admin enters the level and experience points.
    2.2.2 The admin clicks on the set button.
 2.3 If the admin wants to configure the daily missions:
    2.3.1 The admin enters the new daily mission and rewards.
 2.4 If the admin wants to configure the leader board setting:
    2.4.1 The admin selects the leader board setting through the drop-down list.		

2.5 If the admin wants to configure the achievement badges setting:
2.5.1 If the admin wants to delete an achievement badge:
2.5.1.1 The admin clicks on the delete icon for the achievement badge.
2.5.2 If the admin wants to add an achievement badge:
2.5.1.1 The admin clicks on the add icon.
2.5.1.2 The admin uploads an achievement badge image and clicks on the upload button.
Alternate/Exceptional Flows: N/A

Table 4.22: Use Case Description of View Audit Logs.

Use Case Name: View Audit Logs	ID: UC017	Importance Level: Medium
Primary Actor: Admin	Use Case Type: Detail, Essential	
Stakeholders and Interests: N/A		
Brief Description: The use case describes the process of accessing and viewing the audit logs to monitor user activity within the web application.		
Trigger: The admin selects "Audit Logs" from the navigation menu.		
Relationships: Association: Admin		
Normal Flow of Events: 1. The admin selects "Audit Logs" from the navigation menu. 2. The web application displays a list of audit log records. 3. The admin filters through user types, event types, and date range. 4. The web application displays the filter list of audit logs.		
SubFlows: N/A		
Alternate/Exceptional Flows: N/A		

CHAPTER 5

SYSTEM DESIGN

5.1 Introduction

This chapter covers the system architecture design, database design outlined by the conceptual data model, entity relationship diagram (ERD), data dictionary with detailed descriptions, and data flow diagram up to Level 1. Besides, the preliminary user interface design designed via Axure RP9 is also included to provide a brief overview of the web application, along with the flowline diagram for the page navigation by the three different users.

5.2 System Architecture Design
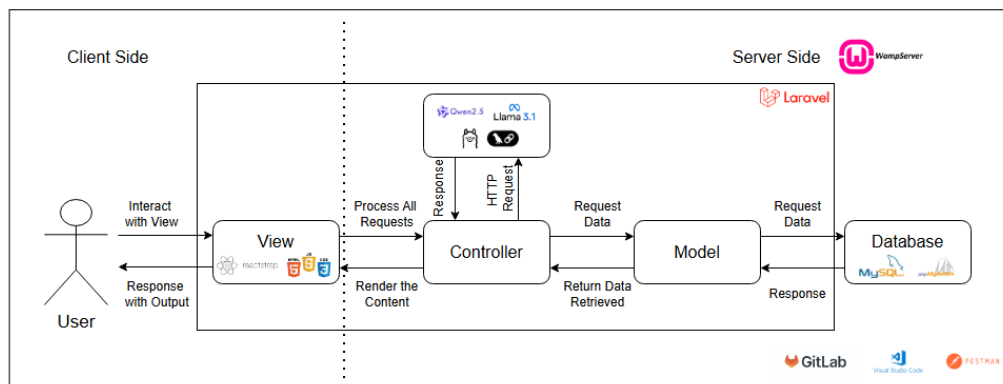
Figure 5.1: System Architecture Design.

The system architecture of the web application is designed to follow the Model-View-Controller (MVC) pattern, with React as the frontend and Laravel as the backend. This allows the AI Study Planner to be integrated through the request controller to handle communication between the frontend and the AI service.

5.3 Database Design

5.3.1 Conceptual Data Model
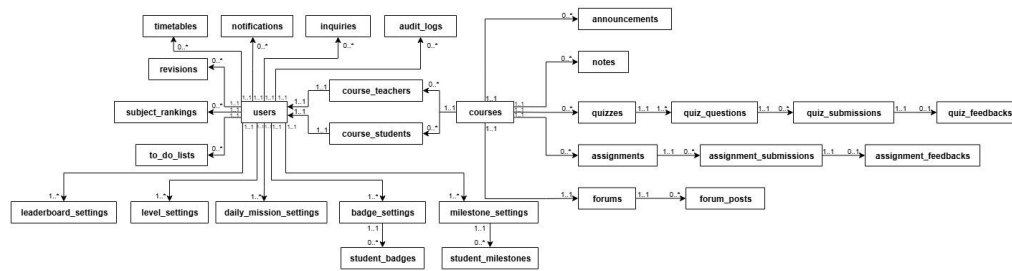
Figure 5.2: Conceptual Data Model.

In the conceptual data model, each student user can have multiple timetable, subject rankings, revision slots, and to-do list records. All users have multiple notifications, inquiries, and audit log records. The user can participate in multiple courses where each of the courses many contain announcements, notes, quizzes, assignments, and forums. The relationship between users and courses is many-to-many, as a user may enroll in several courses and each of the courses may have many participants. Within the course, a quiz can consist of multiple questions and each quiz allows for one submission and one corresponding feedback per user. Similarly, each assignment is linked to a single submission and a single feedback. For admin users, they can manage various system settings which include the leaderboard, level, daily mission, badge, and milestone configurations. In this case, each student user may have more than one badge and milestone record.

5.3.2 Entity Relationship Diagram (ERD)
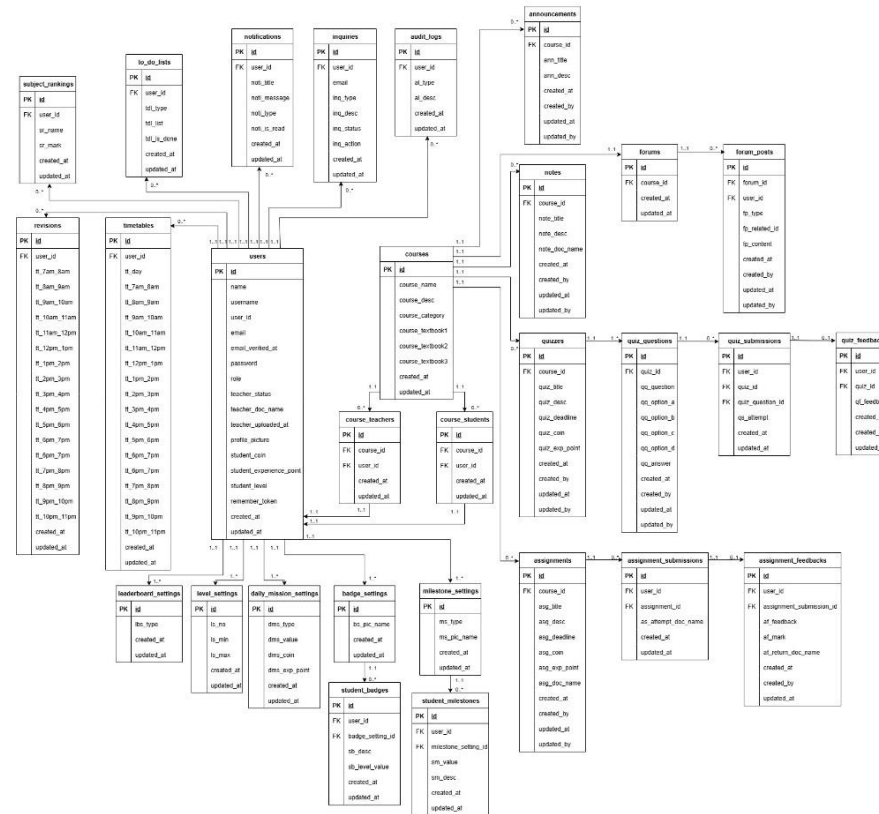
Figure 5.3: Entity Relationship Diagram (ERD)

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5.3.3 List of Tables and Descriptions

The following is the list of all database tables with a brief description of the purpose:

Table 5.1: List of Tables and Descriptions.

Table Name	Description
users	The users table stores all personal, authentication, role, and gamification details for all users which including students, teachers, and administrators, together with the timestamps for creation and update.
courses	The courses table stores the course information, including its name, description, category, associated textbooks, and timestamps for creation and update.
course_teachers	The course_teachers table links teachers to the courses they are assigned to.
course_students	The course_students table links students to the course they are enrolled in.
announcements	The announcements table stores course-related announcements, including the title, description, creator, and timestamps for creation and update.
notes	The notes table stores course-related notes, including the title, description, uploaded document filenames, creator, and timestamps for creation and update.
quizzes	The quizzes table stores the details of course-related quizzes, including the title, description, deadline, rewards, creator, and timestamps.
quiz_questions	The quiz_questions table stores questions for each quiz, including the options, correct answers, creator, and timestamps.
quiz_submissions	The quiz_submissions table stores students' attempts.

quiz_feedbacks	The quiz_feedbacks table stores the feedback provided by the teacher based on the submitted quiz.
assignments	The assignments table stores the details of course-related assignments, including the title, description, deadline, rewards, document, creator, and timestamps.
assignment_ submissions	The assignment_submissions table stores students' attempts.
assignment_ feedbacks	The assignment_feedbacks table stores the feedback provided by the teacher based on the submitted assignment.
forums	The forums table stores course-related forums, including timestamps for creation and update.
forum_posts	The forum_posts table stores all posts and replies within a forum, including the post type, related main post for replies, content, author, and timestamps for creation and update.
timetables	The timetables table stores the student's daily schedule, day of the week, planned activities for every hour from 7 am to 11 pm, and timestamps for creation and update.
subject_rankings	The subject_rankings table stores students' subject performance, including the subject name, mark, and timestamps for creation and update.
revisions	The revisions table stores students' daily available slots for revisions, from 7 am to 11 pm, and timestamps for creation and update.
to_do_lists	The to_do_lists table stores tasks created by the students, including the type of the task, description, completion status, and timestamps for creation and update.
level_settings	The level_settings table stores the configuration for user levels, including the level number, the

	minimum and maximum experience points required, and timestamps for creation and update by the administrator.
leaderboard_settings	The leaderboard_settings table stores the configuration of the leaderboard by the administrators.
daily_mission_settings	The daily_mission_settings table stores the configuration of the daily missions by the administrators.
badge_settings	The badge_settings table stores the configuration of the badges by the administrators.
student_badges	The student_badges table stores the badges obtained by the students.
milestone_settings	The milestone_settings table stores the configuration of the milestones by the administrators.
student_milestones	The student_milestones table stores the milestones achieved by the students.
inquiries	The inquiries table stores the inquiries submitted by the users, including the contact email, inquiry type, description, status, action taken, and timestamps for creation and update.
notifications	The notifications table stores the notifications for users, including the title, message content, type category, read status, and timestamps for creation and update.
audit_logs	The audit_logs table stores the records of user-related system activities, including the type of action performed, description, and timestamps fr creation and update to be tracked by the administrators.

5.3.4 Data Dictionary

The following is the details of each database table, including column names, descriptions, data types, keys, and foreign key relationships:

Table 5.2: The users Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the user.	Bigint Unsigned	Primary Key	
name	The full name of the user.	String		
username	The display name of the user.	String		
user_id	The unique identifier assigned to the user within the game system.	String		
email	The user's email address.	String		
email_verified_at	The timestamp when the user's email address is verified.	Timestamp		
password	The user's hashed password.	String		
role	The role assigned to the user. For example, student, admin, and teacher.	Enum		

teacher_status	The status of the teacher's account. For example, unverified, pending, verified, and rejected.	Enum		
teacher_doc_name	The filename of the teacher's uploaded verification document.	String		
teacher_uploaded_at	The timestamp when the teacher's verification document is uploaded.	Timestamp		
profile_picture	The filename of the user's uploaded profile picture.	String		
student_coin	The coins that the student earned within the game system.	Integer		
student_exp_point	The experience point that the student gained from the game system.	Integer		
student_level	The current level of the student based on the experience points.	Integer		
remember_token	A token used to remember the user's login session across browser sessions.	String		
created_at	The timestamp when the user account is created.	Timestamp		
updated_at	The timestamp when the user's data was last updated.	Timestamp		

Table 5.3: The courses Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course.	Bigint Unsigned	Primary Key	
course_name	The name of the course.	String		
course_desc	The detailed description of the course.	Text		
course_category	The category of the course. For example, lower secondary and upper secondary.	Enum		
course_textbook1	The filename of the primary textbook used in the course.	String		
course_textbook2	The filename of the additional textbook used in the course.	String		
course_textbook3	The filename of the additional textbook used in the course.	String		
created_at	The timestamp when the course record is created.	Timestamp		
updated_at	The timestamp when the course record was last updated.	Timestamp		

Table 5.4: The course_teachers Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table

id	The unique system-generated identifier for the course teacher.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the teacher.	Bigint Unsigned	Foreign Key	id on courses
user_id	The identifier of the teacher assigned to the course.	Bigint Unsigned	Foreign Key	id on users
created_at	The timestamp when the course teacher's record is created.	Timestamp		
updated_at	The timestamp when the course teacher's record was last updated.	Timestamp		

Table 5.5: The course_students Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course student.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the student.	Bigint Unsigned	Foreign Key	id on courses

user_id	The identifier of the student enrolled in the course.	Bigint Unsigned	Foreign Key	id on users
created_at	The timestamp when the course student's record is created.	Timestamp		
updated_at	The timestamp when the course student's record was last updated.	Timestamp		

Table 5.6: The announcements Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course announcement.	Bigint Unsigned	Foreign Key	
course_id	The identifier of the course associated with the announcement.	Bigint Unsigned	Foreign Key	id on courses
ann_title	The title of the announcement	String		
ann_desc	The detailed description of the announcement.	Text		
created_at	The timestamp when the course announcement is created.	Timestamp		
created_by	The identifier of the user who created the announcement.	Bigint Unsigned		

| updated_at | The timestamp when the course announcement was last updated. | Timestamp | | |
| updated_by | The identifier of the user who last updated the announcement. | Bigint Unsigned | | |

Table 5.7: The notes Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course note.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the note.	Bigint Unsigned	Foreign Key	id on courses
note_title	The title of the note.	String		
note_desc	The detailed description of the note.	Text		
note_doc_name	The filename of the uploaded note.	String		
created_at	The timestamp when the course note is created.	Timestamp		
created_by	The identifier of the user who created the note.	Bigint Unsigned		

Column Name	Description	Data Type		
updated_at	The timestamp when the course note was last updated.	Timestamp		
updated_by	The identifier of the user who last updated the note.	Bigint Unsigned		

Table 5.8: The quizzes Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course quiz.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the quiz.	Bigint Unsigned	Foreign Key	id on courses
quiz_title	The title of the quiz.	String		
quiz_desc	The detailed description of the quiz.	Text		
quiz_deadline	The submission deadline for the quiz.	Timestamp		
quiz_coin	The number of coins rewarded to the student after submitting the quiz.	Integer		
quiz_exp_point	The amount of experience points awarded to the student after submitting the quiz.	Integer		

created_at	The timestamp when the course quiz is created.	Timestamp		
created_by	The identifier of the user who created the quiz.	Bigint Unsigned		
updated_at	The timestamp when the course quiz was last updated.	Timestamp		
updated_by	The identifier of the user who last updated the quiz.	Bigint Unsigned		

Table 5.9: The quiz_questions Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the quiz question.	Bigint Unsigned	Primary Key	
quiz_id	The identifier of the quiz associated with the quiz question.	Bigint Unsigned	Foreign Key	id on quizzes
qq_question	The question of the quiz.	Text		
qq_option_a	Option A of the quiz.	Text		
qq_option_b	Option B of the quiz.	Text		
qq_option_c	Option C of the quiz.	Text		

qq_option_d	Option D of the quiz.	Text		
qq_answer	The answer to the quiz.	String		
created_at	The timestamp when the quiz question is created.	Timestamp		
created_by	The identifier of the user who created the quiz question.	Bigint Unsigned		
updated_at	The timestamp when the quiz question was last updated.	Timestamp		
updated_by	The identifier of the user who last updated the quiz question.	Bigint Unsigned		

Table 5.10: The quiz_submissions Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the quiz submission.	Bigint Unsigned	Primary Key	
user_id	The identifier of the student who submitted the quiz.	Bigint Unsigned	Foreign Key	id on users
quiz_id	The identifier of the quiz submission associated with the quiz.	Bigint Unsigned	Foreign Key	id on quizzes

quiz_question_id	The identifier of the quiz submission associated with the quiz question.	Bigint Unsigned	Foreign Key	id on quiz_questions
qs_attempt	The attempted answer by the student.	String		
created_at	The timestamp when the quiz submission is created.	Timestamp		
updated_at	The timestamp when the quiz submission was last updated.	Timestamp		

Table 5.11: The quiz_feedbacks Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the quiz feedback.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user who submitted the quiz.	Bigint Unsigned	Foreign Key	id on users
quiz_id	The identifier of the quiz feedback associated with the quiz submission.	Bigint Unsigned	Foreign Key	quiz_id on quiz_ submissions
qf_feedback	The feedback provided by the teacher.	Text		
created_at	The timestamp when the quiz feedback is created.	Timestamp		

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
created_by	The identifier of the user who created the quiz feedback.	Bigint Unsigned		
updated_at	The timestamp when the quiz feedback was last updated.	Timestamp		

Table 5.12: The assignments Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course assignment.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the assignment.	Bigint Unsigned	Foreign Key	id on courses
asg_title	The title of the assignment.	String		
asg_desc	The detailed description of the assignment.	Text		
asg_deadline	The submission deadline for the assignment.	Timestamp		
asg_coin	The number of coins rewarded to the student after submitting the assignment.	Integer		
asg_exp_point	The amount of experience points awarded to the student after submitting the assignment.	Integer		

asg_doc_name	The filename of the assignment.	String		
created_at	The timestamp when the course assignment is created.	Timestamp		
created_by	The identifier of the user who created the assignment.	Bigint Unsigned		
updated_at	The timestamp when the course assignment was last updated.	Timestamp		
updated_by	The identifier of the user who last updated the assignment.	Bigint Unsigned		

Table 5.13: The assignment_submissions Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for assignment submission.	Bigint Unsigned	Primary Key	
user_id	The identifier of the student who submitted the assignment.	Bigint Unsigned	Foreign Key	id on users
assignment_id	The identifier of the assignment submission associated with the assignment.	Bigint Unsigned	Foreign Key	id on assignments

as_attempt_doc_na me	The filename of the submitted assignment.	String		
created_at	The timestamp when the assignment submission is created.	Timestamp		
updated_at	The timestamp when the assignment submission was last updated.	Timestamp		

Table 5.14: The assignment_feedbacks Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the assignment feedback.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user who submitted the assignment.	Bigint Unsigned	Foreign Key	id on users
assignment_submiss ion_id	The identifier of the assignment feedback associated with the assignment submission.	Bigint Unsigned	Foreign Key	id on assignmen_ submissions
af_feedback	The feedback provided by the teacher.	Text		
af_mark	The mark of the submitted assignment.	Integer		

af_return_doc_nam e	The filename of the marked assignment.	String		
created_at	The timestamp when the assignment feedback is created.	Timestamp		
created_by	The identifier of the user who created the quiz feedback.	Bigint Unsigned		
updated_at	The timestamp when the quiz feedback was last updated.	Timestamp		

Table 5.15: The forums Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the course forum.	Bigint Unsigned	Primary Key	
course_id	The identifier of the course associated with the forum.	Bigint Unsigned	Foreign Key	id on courses
created_at	The timestamp when the course forum is created.	Timestamp		
updated_at	The timestamp when the course forum was last updated.	Timestamp		

Table 5.16: The forum_posts Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the forum post.	Bigint Unsigned	Primary Key	
forum_id	The identifier of the forum post associated with the forum.	Bigint Unsigned	Foreign Key	id on forums
user_id	The identifier of the user who posts or replies.	Bigint Unsigned	Foreign Key	id on users
fp_type	The type of the forum post. For example, post and reply.	Enum		
fp_related_id	The identifier of the forum reply associated with the forum main post.	Bigint Unsigned		
fp_content	The content of the forum post.	Text		
created_at	The timestamp when the forum post is created.	Timestamp		
created_by	The identifier of the user who created the forum post.	Bigint Unsigned		
updated_at	The timestamp when the forum post was last updated.	Timestamp		

updated_by	The identifier of the user who last updated the forum post.	Bigint Unsigned		

Table 5.17: The timetables Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the timetable.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the timetable.	Bigint Unsigned	Foreign Key	id on users
tt_day	The day of the timetable, from Monday to Sunday.	Enum		
tt_7am_8am	Activity between 7 am to 8 am.	Enum		
tt_8am_9am	Activity between 8 am to 9 am.	Enum		
tt_9am_10am	Activity between 9 am to 10 am.	Enum		
tt_10am_11am	Activity between 10 am to 11 am.	Enum		
tt_11am_12pm	Activity between 11 am to 12 pm.	Enum		
tt_12pm_1pm	Activity between 12 pm to 1 pm.	Enum		
tt_1pm_2pm	Activity between 1 pm to 2 pm.	Enum		

tt_2pm_3pm	Activity between 2 pm to 3 pm.	Enum		
tt_3pm_4pm	Activity between 3 pm to 4 pm.	Enum		
tt_4pm_5pm	Activity between 4 pm to 5 pm.	Enum		
tt_5pm_6pm	Activity between 5 pm to 6 pm.	Enum		
tt_6pm_7pm	Activity between 6 pm to 7 pm.	Enum		
tt_7pm_8pm	Activity between 7 pm to 8 pm.	Enum		
tt_8pm_9pm	Activity between 8 pm to 9 pm.	Enum		
tt_9pm_10pm	Activity between 9 pm to 10 pm.	Enum		
tt_10pm_11pm	Activity between 10 pm to 11 pm.	Enum		
created_at	The timestamp when the timetable record is created.	Timestamp		
updated_at	The timestamp when the timetable record was last updated.	Timestamp		

Table 5.18: The subject_rankings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table

id	The unique system-generated identifier for the subject ranking.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the subject ranking.	Bigint Unsigned	Foreign Key	id on users
sr_name	The name of the subject.	Enum		
sr_mark	The mark of the subject.	Integer		
created_at	The timestamp when the subject ranking is created.	Timestamp		
updated_at	The timestamp when the subject ranking was last updated.	Timestamp		

Table 5.19: The revisions Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the revision.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the revision.	Bigint Unsigned	Foreign Key	id on users
tt_7am_8am	Indicates whether the timeslot from 7 am to 8 am is scheduled or available.	Boolean		

tt_8am_9am	Indicates whether the timeslot from 8 am to 9 am is scheduled or available.	Boolean		
tt_9am_10am	Indicates whether the timeslot from 9 am to 10 am is scheduled or available.	Boolean		
tt_10am_11am	Indicates whether the timeslot from 10 am to 11 am is scheduled or available.	Boolean		
tt_11am_12pm	Indicates whether the timeslot from 11 am to 12 pm is scheduled or available.	Boolean		
tt_12pm_1pm	Indicates whether the timeslot from 12 pm to 1 pm is scheduled or available.	Boolean		
tt_1pm_2pm	Indicates whether the timeslot from 1 pm to 2 pm is scheduled or available.	Boolean		
tt_2pm_3pm	Indicates whether the timeslot from 2 pm to 3 pm is scheduled or available.	Boolean		
tt_3pm_4pm	Indicates whether the timeslot from 3 pm to 4 pm is scheduled or available.	Boolean		
tt_4pm_5pm	Indicates whether the timeslot from 4 pm to 5 pm is scheduled or available.	Boolean		

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
tt_5pm_6pm	Indicates whether the timeslot from 5 pm to 6 pm is scheduled or available.	Boolean		
tt_6pm_7pm	Indicates whether the timeslot from 6 pm to 7 pm is scheduled or available.	Boolean		
tt_7pm_8pm	Indicates whether the timeslot from 7 pm to 8 pm is scheduled or available.	Boolean		
tt_8pm_9pm	Indicates whether the timeslot from 8 pm to 9 pm is scheduled or available.	Boolean		
tt_9pm_10pm	Indicates whether the timeslot from 9 pm to 10 pm is scheduled or available.	Boolean		
tt_10pm_11pm	Indicates whether the timeslot from 10 pm to 11 pm is scheduled or available.	Boolean		
created_at	The timestamp when the revision record is created.	Timestamp		
updated_at	The timestamp when the revision record was last updated.	Timestamp		

Table 5.20: The to_do_lists Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table

id	The unique system-generated identifier for the to-do list.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the to-do list.	Bigint Unsigned	Foreign Key	id on users
tdl_type	The type of the to-do list. For example, daily, weekly, and monthly.	Enum		
tdl_list	The to-do list item.	Text		
tdl_is_done	Indicates whether the to-do list is completed or not.	Boolean		
created_at	The timestamp when the to-do list is created.	Timestamp		
updated_at	The timestamp when the to-do list was last updated.	Timestamp		

Table 5.21: The level_settings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the level setting.	Bigint Unsigned	Primary Key	
ls_no	The level number.	Integer		
ls_min	The minimum experience points required for the level.	Integer		

ls_max	The maximum experience points allowed for the level.	Integer		
created_at	The timestamp when the level setting is created.	Timestamp		
updated_at	The timestamp when the level setting was last updated.	Timestamp		

Table 5.22: The leaderboard_settings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the leaderboard setting.	Bigint Unsigned	Primary Key	
lbs_type	The configuration for leaderboard criteria. For example, student coins, student experience points, and student level.	Enum		
created_at	The timestamp when the leaderboard setting is created.	Timestamp		
updated _at	The timestamp when the leaderboard setting was last updated.	Timestamp		

Table 5.23: The daily_mission_settings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the daily mission setting.	Bigint Unsigned	Primary Key	
dms_type	The type of daily mission item. For example, an assignment, a quiz, a plan, a timetable, and a to-do list.	Enum		
dms_value	The value of the daily mission item to be completed.	Integer		
dms_coin	The number of coins rewarded to the student after completing the daily mission item.	Integer		
dms_exp_point	The amount of experience points awarded to the student after completing the daily mission item.	Integer		
created_at	The timestamp when the daily mission setting is created.	Timestamp		
updated_at	The timestamp when the daily mission setting was last updated.	Timestamp		

Table 5.24: The badge_settings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the badge setting.	Bigint Unsigned	Primary Key	
bs_pic_name	The filename of the badge.	String		
created_at	The timestamp when the badge setting is created.	Timestamp		
updated_at	The timestamp when the badge setting was last updated.	Timestamp		

Table 5.25: The student_badges Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the student badge.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the student badge.	Bigint Unsigned	Foreign Key	id on users
badge_setting_id	The identifier of the student badge associated with the badge.	Bigint Unsigned	Foreign Key	id on badge_settings

sb_desc	The detailed description of the student badge.	Text		
sb_level_value	The value of the level for the badge obtained.	Integer		
created_at	The timestamp when the student badge record is created.	Timestamp		
updated_at	The timestamp when the student badge record was last updated.	Timestamp		

Table 5.26: The milestone_settings Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the milestone setting.	Bigint Unsigned	Primary Key	
ms_type	The type of the milestone. For example, assignment, coin, course, experience point, level, and quiz.	Enum		
ms_pic_name	The filename of the milestone.	String		
created_at	The timestamp when the milestone setting is created.	Timestamp		
updated_at	The timestamp when the milestone setting was last updated.	Timestamp		

Table 5.27: The student_milestones Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the student milestone.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the student milestone.	Bigint Unsigned	Foreign Key	id on users
milestone_setting_id	The identifier of the student milestone associated with the milestone setting.	Bigint Unsigned	Foreign Key	id on milestone_settings
sm_value	The value of the criteria for the badge obtained.	Bigint Unsigned		
sm_desc	The detailed description of the student milestone.	Text		
created_at	The timestamp when the student milestone record is created.	Timestamp		
updated_at	The timestamp when the student milestone record was last updated.	Timestamp		

Table 5.28: The inquiries Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the inquiry.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the inquiry.	Bigint Unsigned	Foreign Key	id on users
email	The email that was provided by the user.	String		
inq_type	The inquiry type category.	Enum		
inq_desc	The detailed description of the inquiry.	Text		
inq_status	The inquiry status. For example, pending, in-progress, and closed.	Enum		
inq_action	The detailed description of the action taken for the inquiry.	Text		
created_at	The timestamp when the inquiry record is created.	Timestamp		
updated_at	The timestamp when the inquiry record was last updated.	Timestamp		

Table 5.29: The notifications Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the notification.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the notification.	Bigint Unsigned	Foreign Key	id on users
noti_title	The title of the notification.	Text		
noti_message	The detailed description of the notification.	Text		
noti_type	The category type of notification. For example, account, course, announcement, note, quiz, assignment, forum, gaming, and inquiry.	Enum		
noti_is_read	Indicates whether the notification has been read or not.	Boolean		
created_at	The timestamp when the notification is created.	Timestamp		
updated_at	The timestamp when the notification was last updated.	Tinestamp		

Table 5.30: The audit_logs Table Data Dictionary.

Column Name	Description	Data Type	Primary Key/ Foreign Key	Foreign Key Referenced Table
id	The unique system-generated identifier for the audit log.	Bigint Unsigned	Primary Key	
user_id	The identifier of the user associated with the audit log.	Bigint Unsigned	Foreign Key	id on users
al_type	The type of the audit log. For example, creation, updation, and deletion.	Enum		
al_desc	The detailed description of the audit log.	Text		
created_at	The timestamp when the audit log is created.	Timestamp		
updated_at	The timestamp when the audit log was last updated.	Timestamp		

5.3.5 Data Flow Diagram
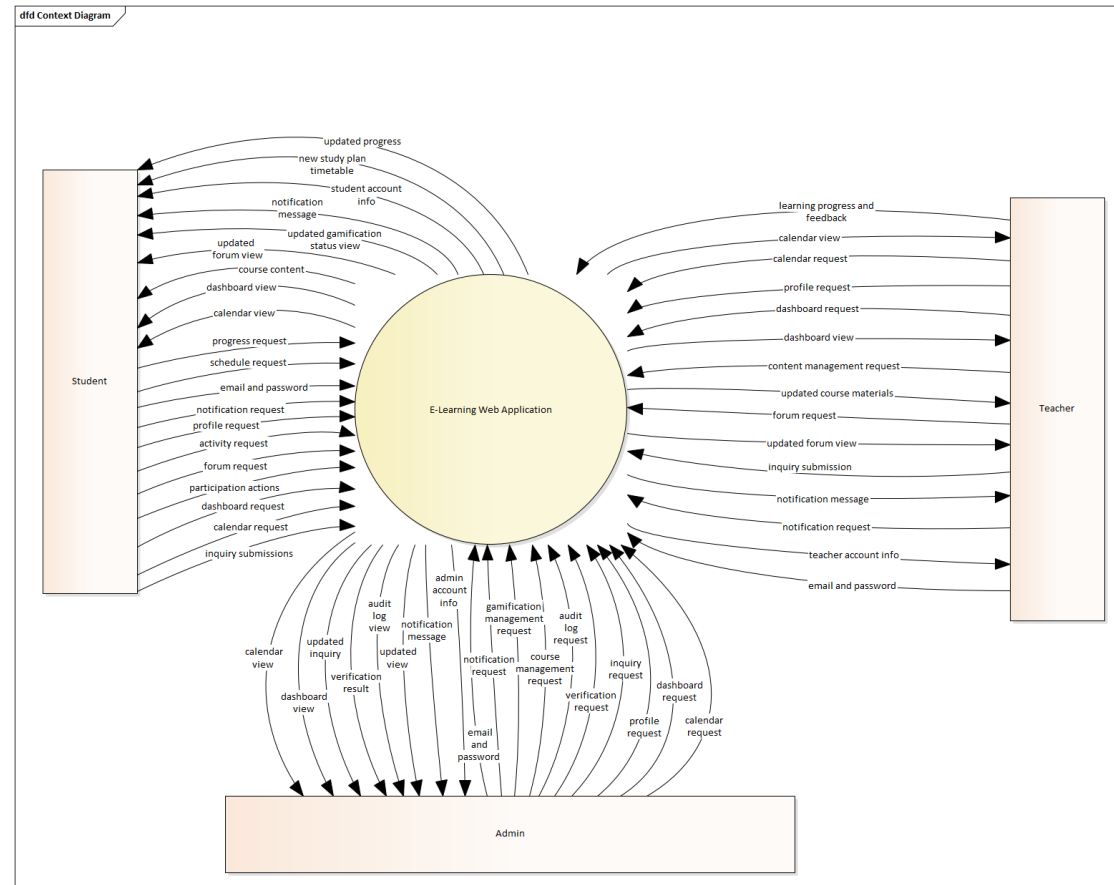
Figure 5.4: Context Diagram.
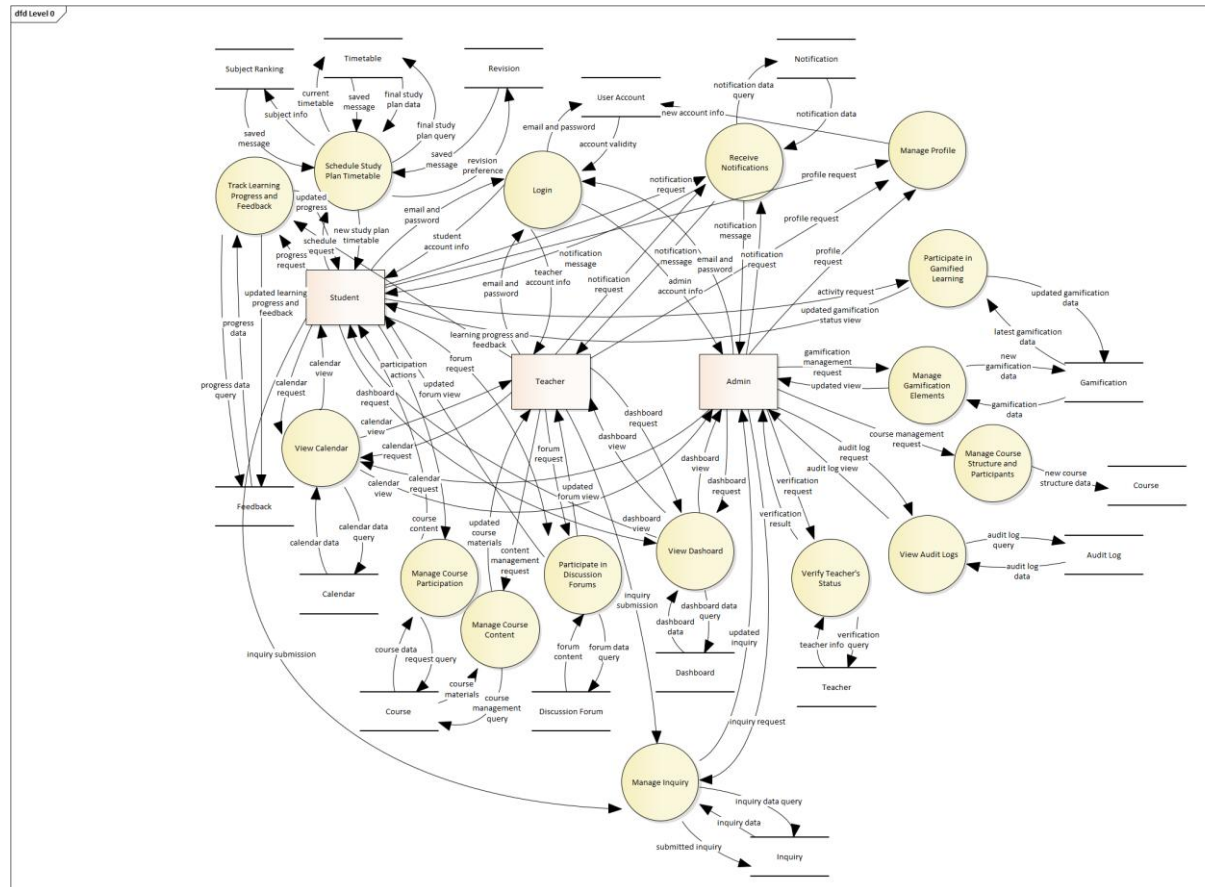
Figure 5.5: Level 0 Data Flow Diagram.
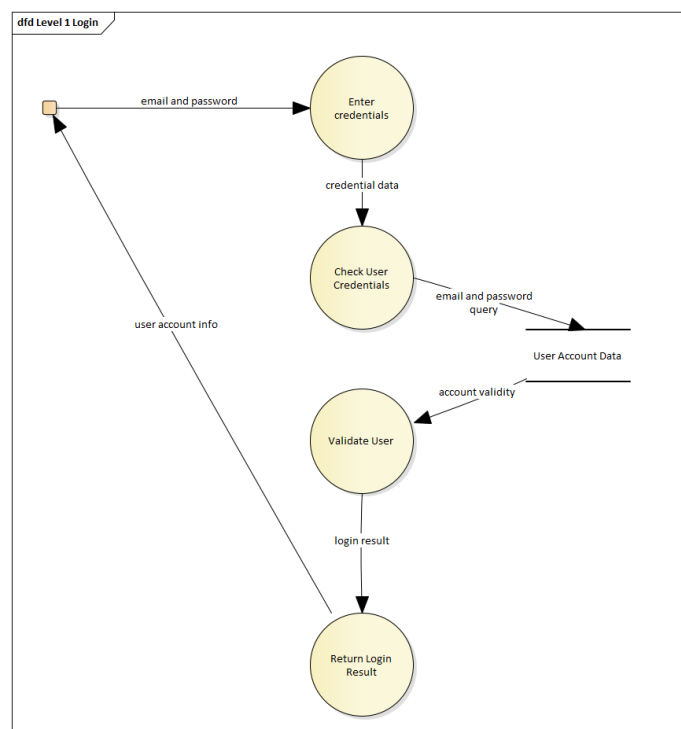
Figure 5.6: Level 1 Data Flow Diagram for Login Process.
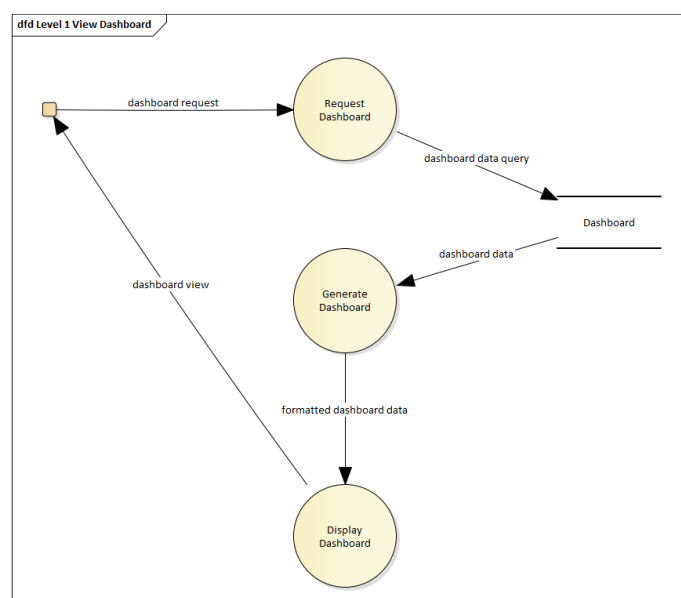
Figure 5.7: Level 1 Data Flow Diagram for View Dashboard Process.
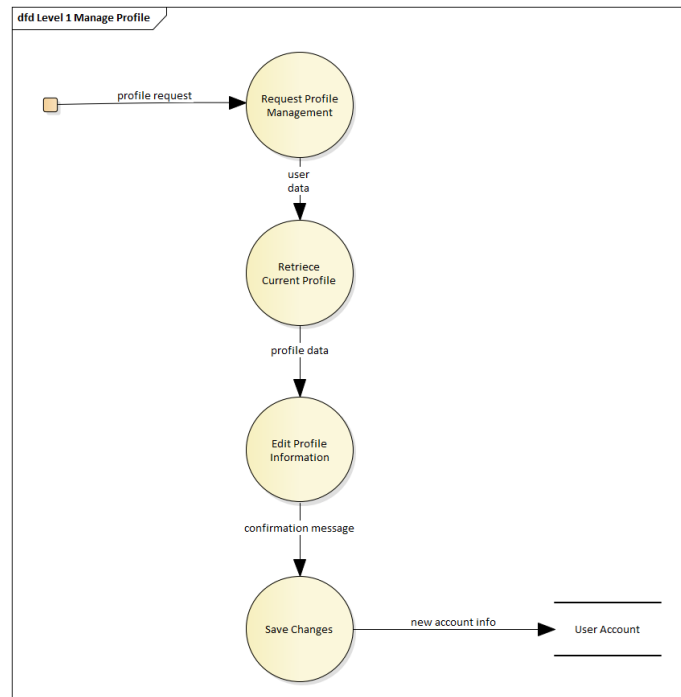
Figure 5.8: Level 1 Data Flow Diagram for Manage Profile Process.
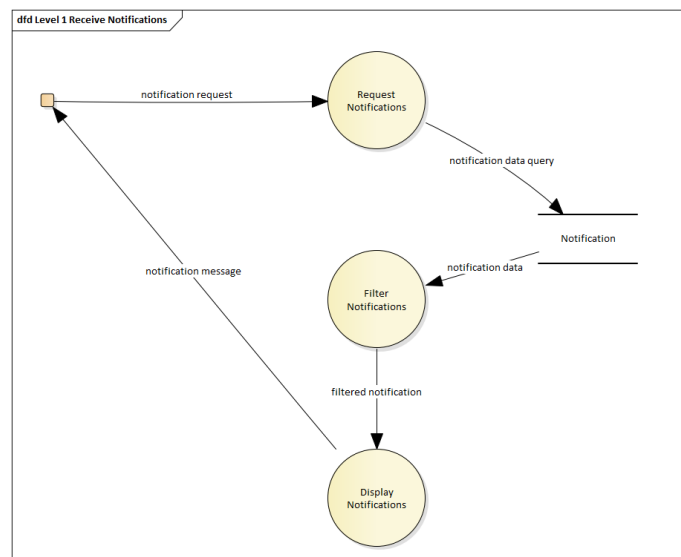
Figure 5.9: Level 1 Data Flow Diagram for Receive Notifications Process.
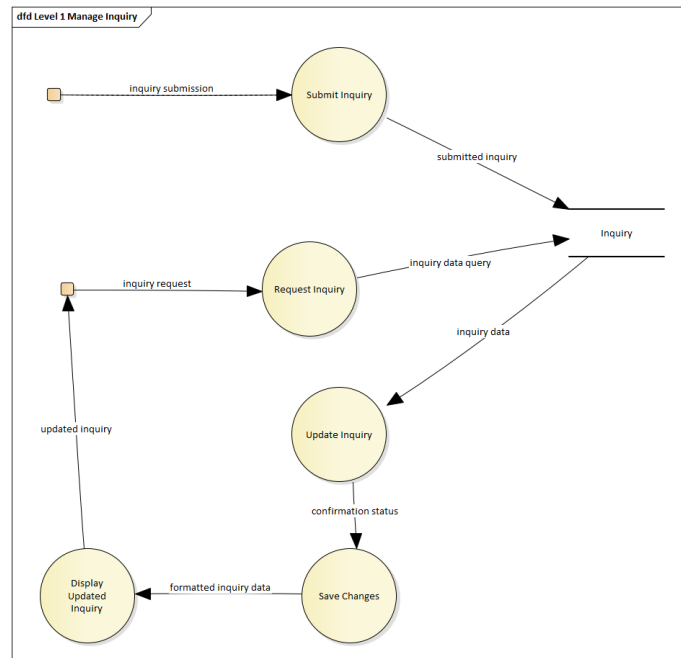
Figure 5.10:   Level 1 Data Flow Diagram for Manage Inquiry Process.
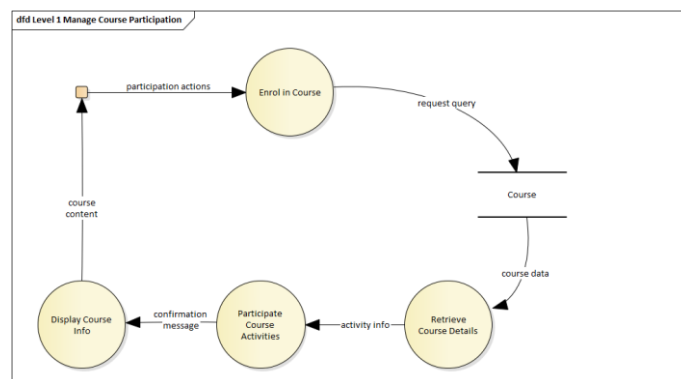
Figure 5.11:   Level 1 Data Flow Diagram for Manage Course Participation

Process.
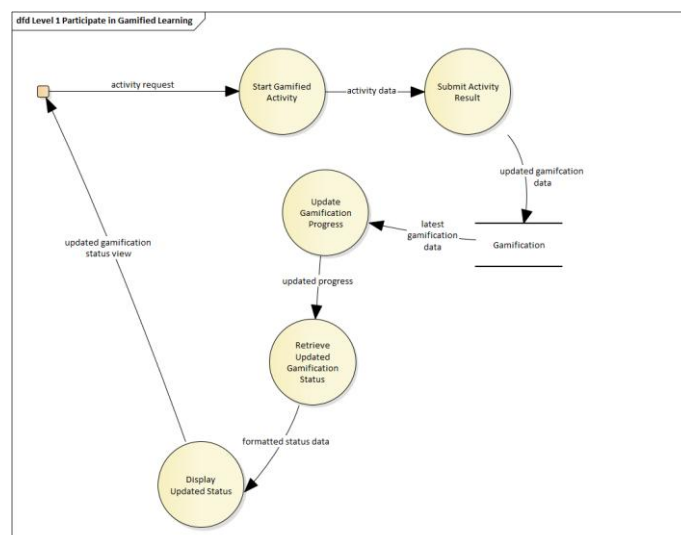
Figure 5.12:   Level 1 Data Flow Diagram for Participate in Gamified

Learning Process.
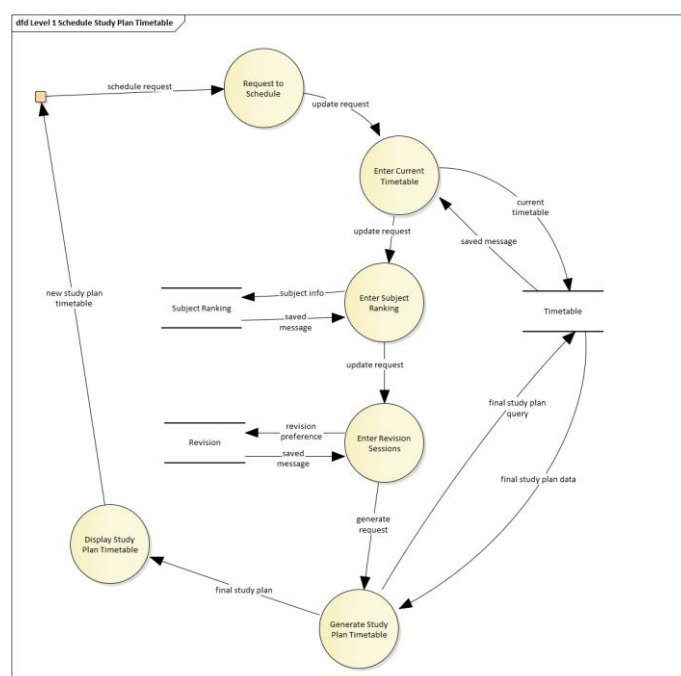
Figure 5.13:   Level 1 Data Flow Diagram for Schedule Study Plan

Timetable Process.
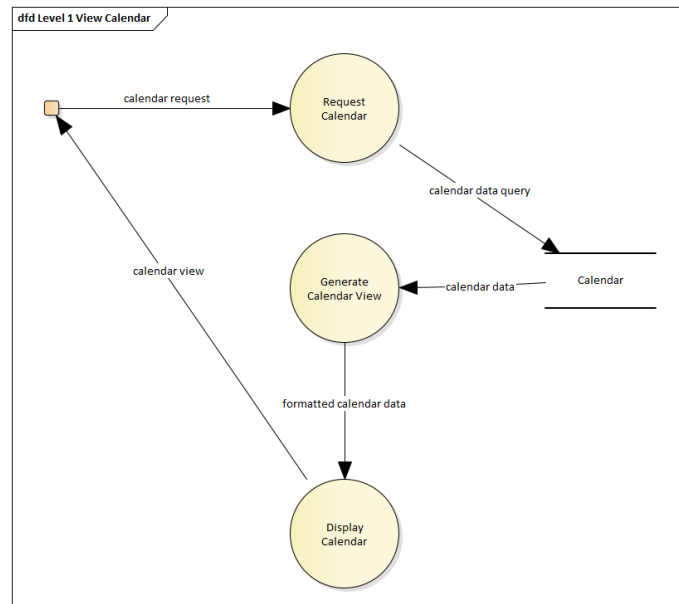
Figure 5.14:   Level 1 Data Flow Diagram for View Calendar Process.
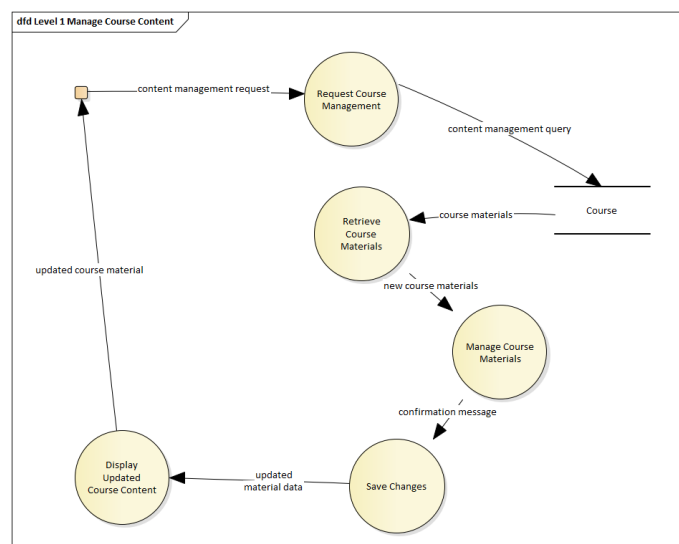
Figure 5.15:   Level 1 Data Flow Diagram for Manage Course Content

Process.
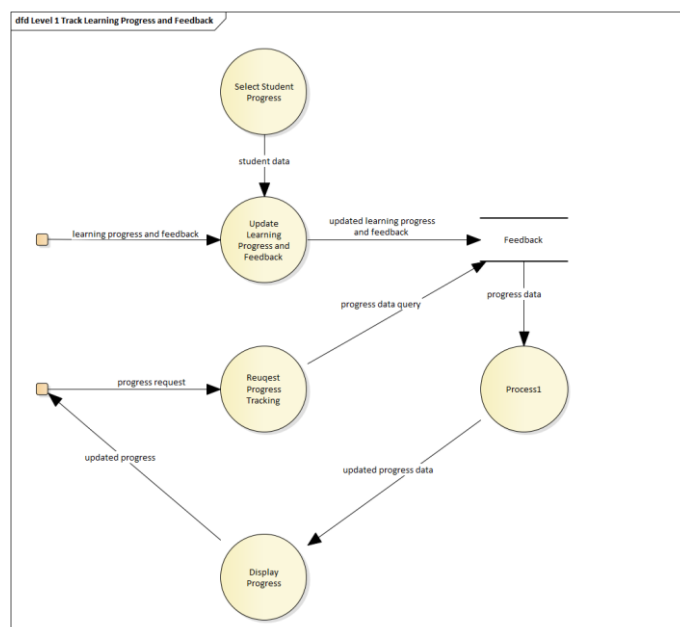
Figure 5.16:   Level 1 Data Flow Diagram for Track Learning Progress and Feedback Process.
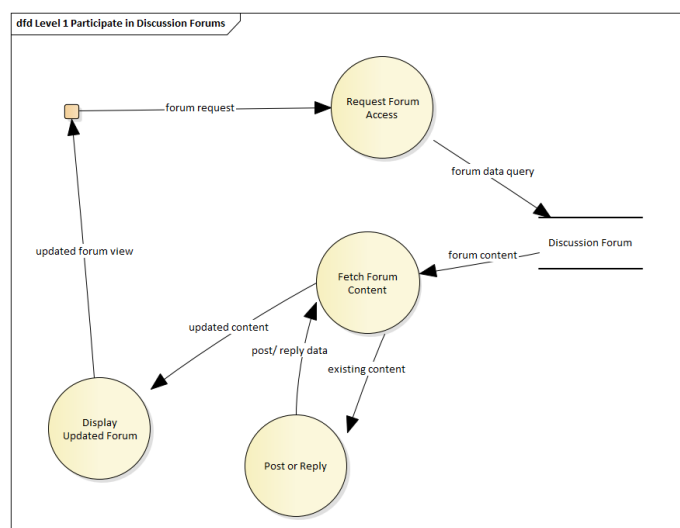
Figure 5.17:   Level 1 Data Flow Diagram for Participate in Discussion Forums Process.
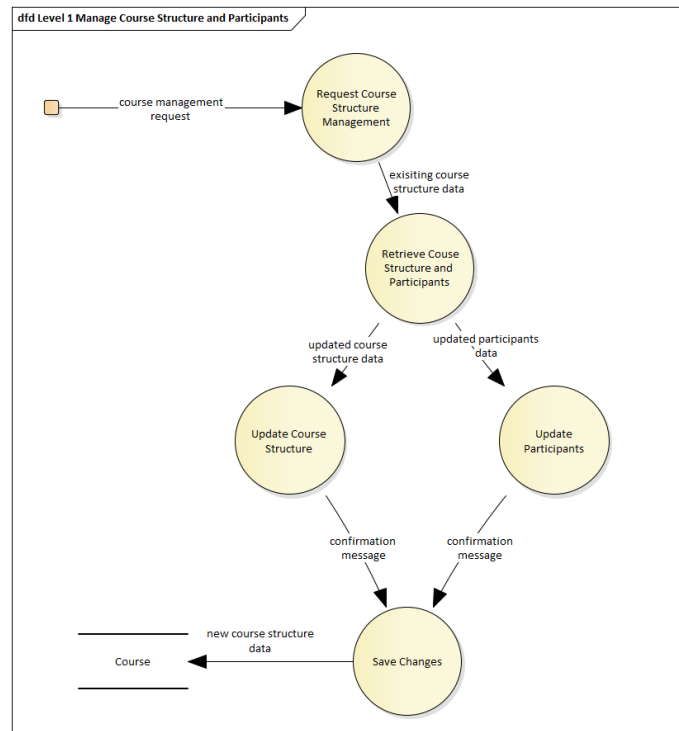
Figure 5.18:   Level 1 Data Flow Diagram for Manage Course Structure
and Participants Process.
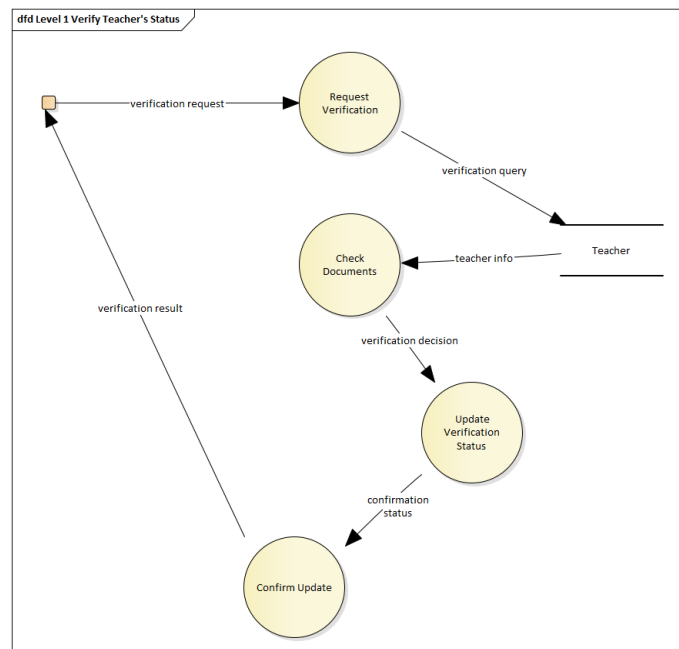
Figure 5.19:   Level 1 Data Flow Diagram for Verify Teacher's Status
Process.
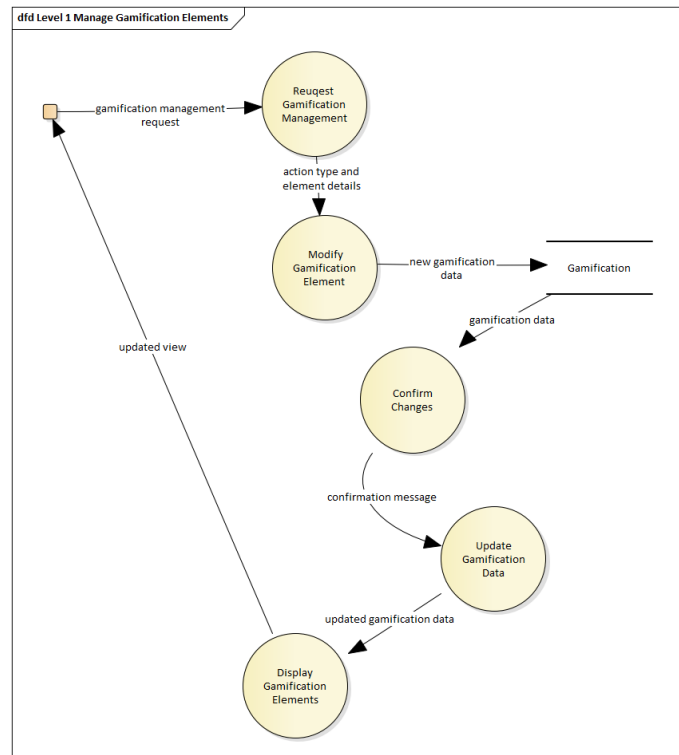
Figure 5.20:   Level 1 Data Flow Diagram for Manage Gamification Elements Process.
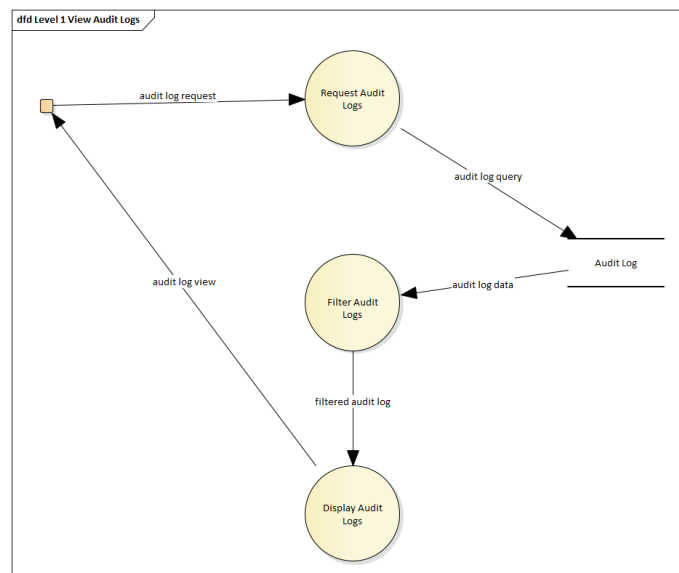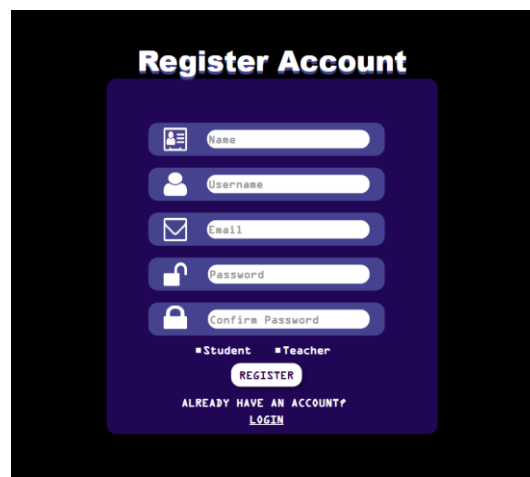

Figure 5.21:   Level 1 Data Flow Diagram for View Audit Logs Process.

5.4   Preliminary User Interface Design

The initial user interface design of the web application using Axure RP9 is included for the three different modules: students, teachers, and administrators. However, the actual implementation may vary slightly for each user type throughout the web application.

5.4.1   All Modules

5.4.1.1   Registration Page

Figure 5.22:   Registration Page.

5.4.1.2   Login Page

Figure 5.23:   Login Page.

5.4.2   Student Module

5.4.2.1   Student's Profile Page
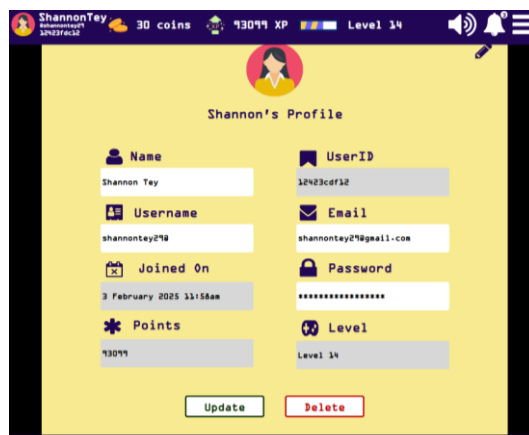
Figure 5.24:   Student's Profile Page.

5.4.2.2   List of Courses Page

Figure 5.25:   List of Courses Page for Enrollment.

5.4.2.3   Course Page
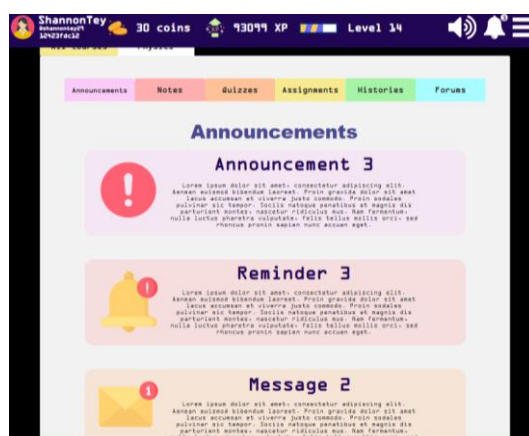
Figure 5.26:   Course Announcement Tab.
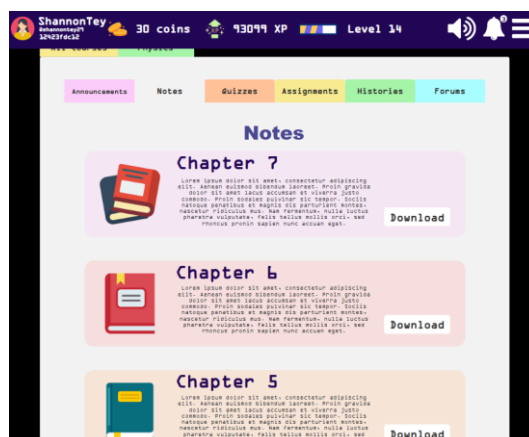
Figure 5.27:   Course Note Tab.
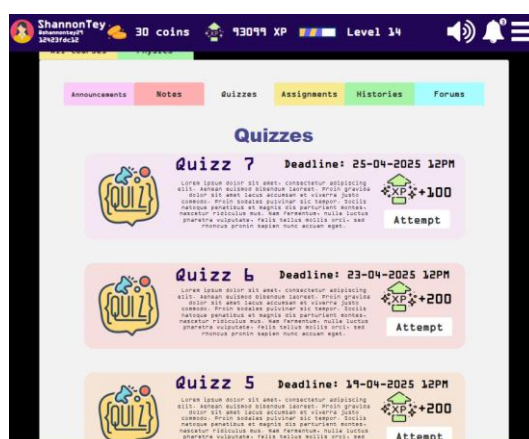
Figure 5.28:   Course Quiz Tab.
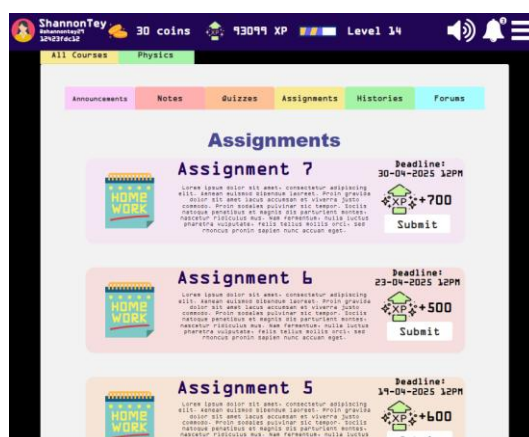
Figure 5.29:   Course Assignment Tab.
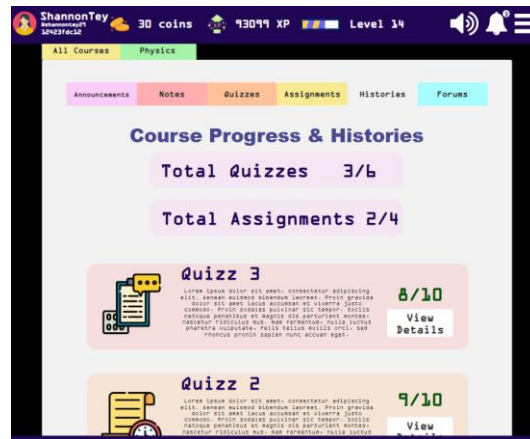
Figure 5.30: Course Progress and History Tab.
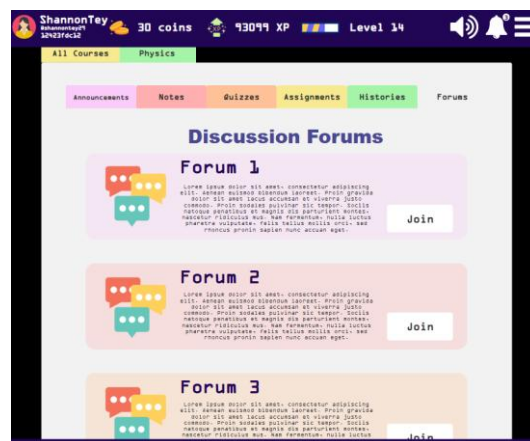
Figure 5.31:　　　Course Discussion Forum Tab.
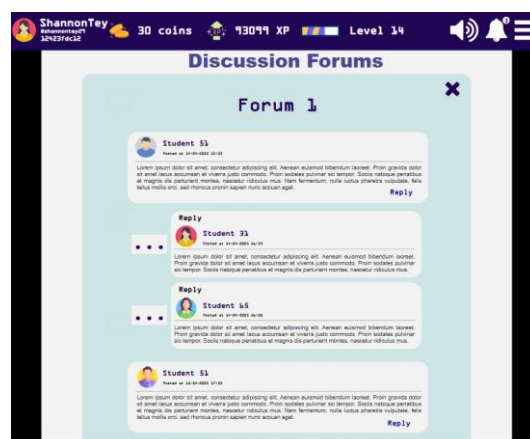
Figure 5.32:　　　Chats in the Discussion Forum.

5.4.2.4 Study Plan Timetable Page

Figure 5.33:   Study Planner and Subjects Ranking Section.

5.4.2.5 Calendar Page

Figure 5.34:   Calendar Page.

5.4.2.6 Dashboard Page

Figure 5.35:   Personalized Dashboard Page.

5.4.2.7 Leaderboard Page
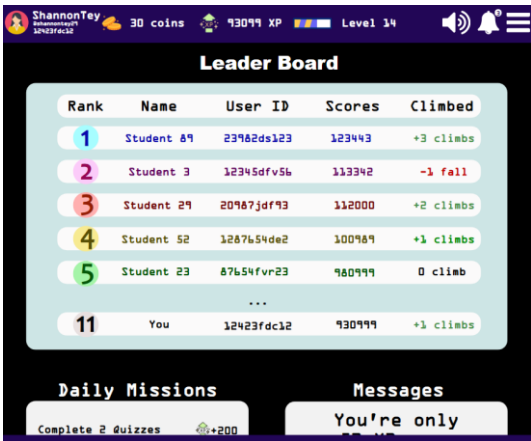
Figure 5.36:   Leaderboard Page.

5.4.2.8 Badges, Achievements, and Milestones Page

Figure 5.37:   Badges, Achievements, and Milestones Page.

5.4.2.9 FAQs Page
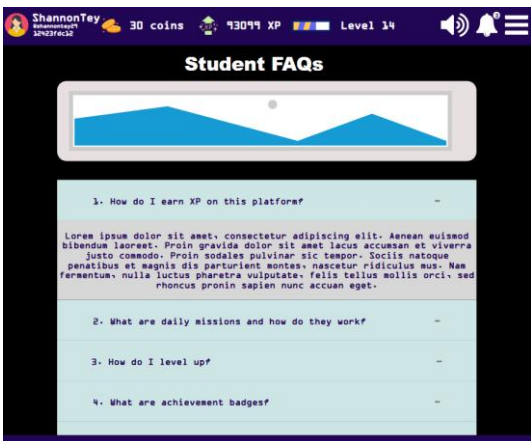
Figure 5.38:   FAQs Page.

5.4.2.10 Inquiry Page

Figure 5.39:   Inquiry Page.

5.4.3   Admin Module

5.4.3.1   Dashboard and Analytics Page

Figure 5.40:   Personalized Dashboard and System Analytics Page.

5.4.3.2   User Account and Profile Management Page

Figure 5.41:   Displayed Student's Profile After Searching.

5.4.3.3 Teacher Status Verification Page
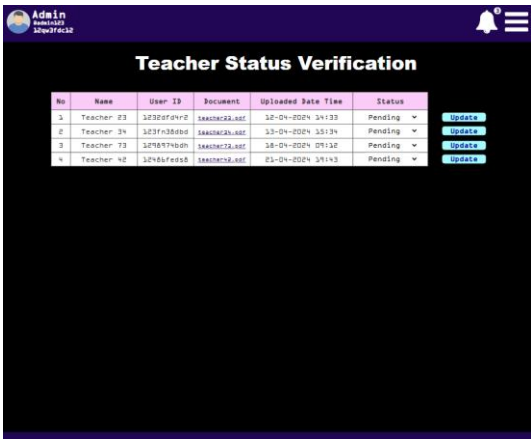
Figure 5.42:   Teacher Status Verification Page.

5.4.3.4 Gamification Management Page
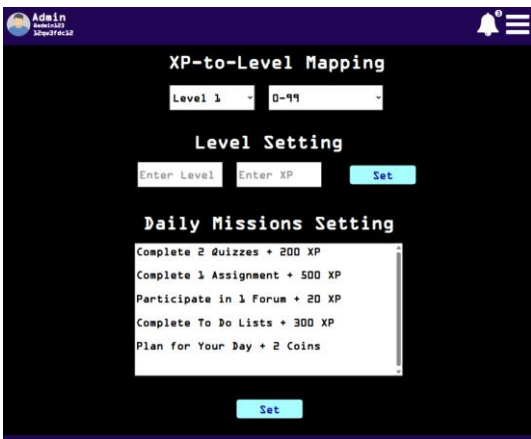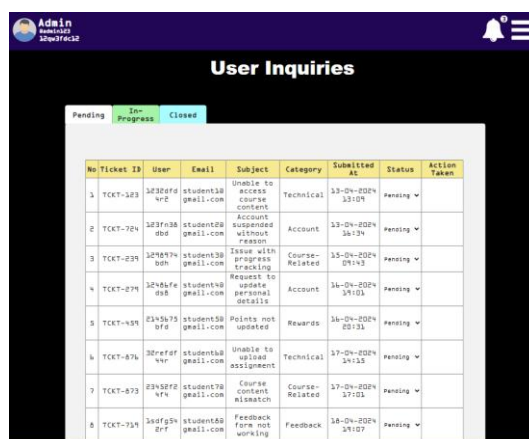
Figure 5.43:   Gamification Management Page.

Figure 5.44:   Gamification Management Page.

5.4.3.5 User Inquiries Page

Figure 5.45: User Inquiries Management Page.

5.4.3.6 Audit Logs Page

Figure 5.46: Audit Logs Page.

5.4.4 Teacher Module

5.4.4.1 Teacher's Profile Page

Figure 5.47: Teacher's Profile Page.

5.4.4.2 Course and Content Management Page
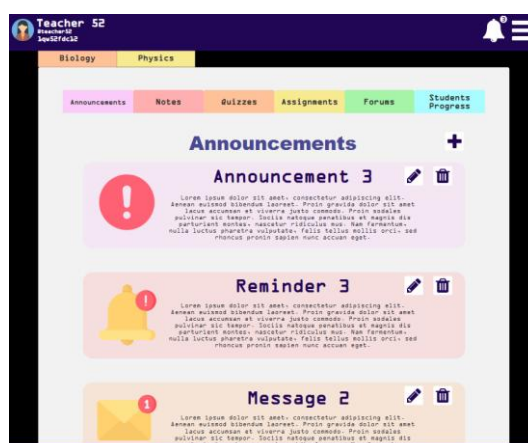
Figure 5.48:   Course Announcement Management Tab.
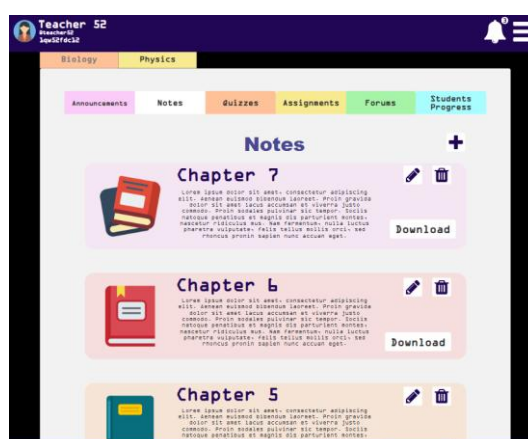
Figure 5.49:   Course Note Management Tab.
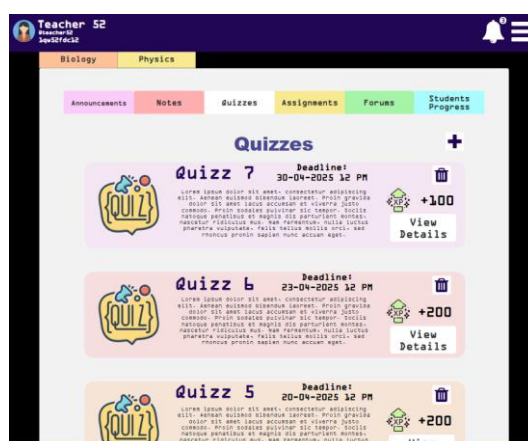
Figure 5.50:   Course Quiz Management Tab.
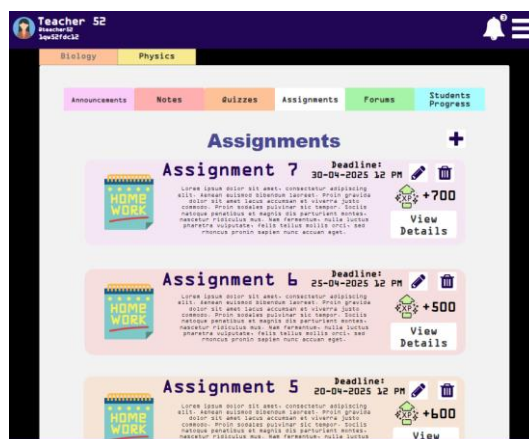
Figure 5.51:   Course Assignment Management Tab.
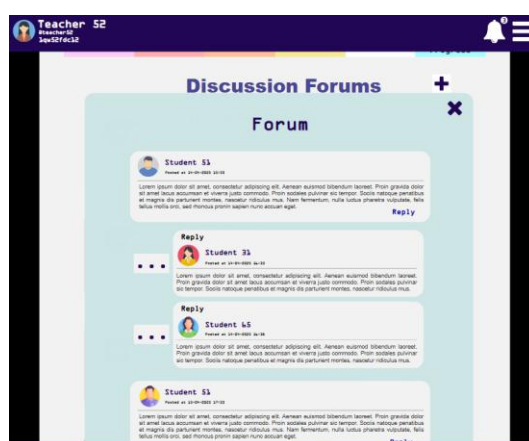
Figure 5.52:   Managing Chats in the Discussion Forum.
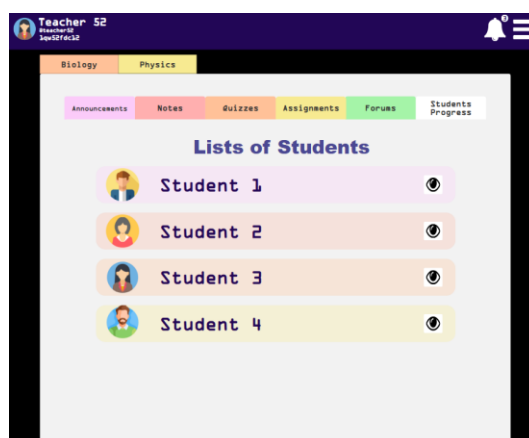
Figure 5.53:   Course Student Progress Tab.

5.5 Flowline

5.5.1 Student Module
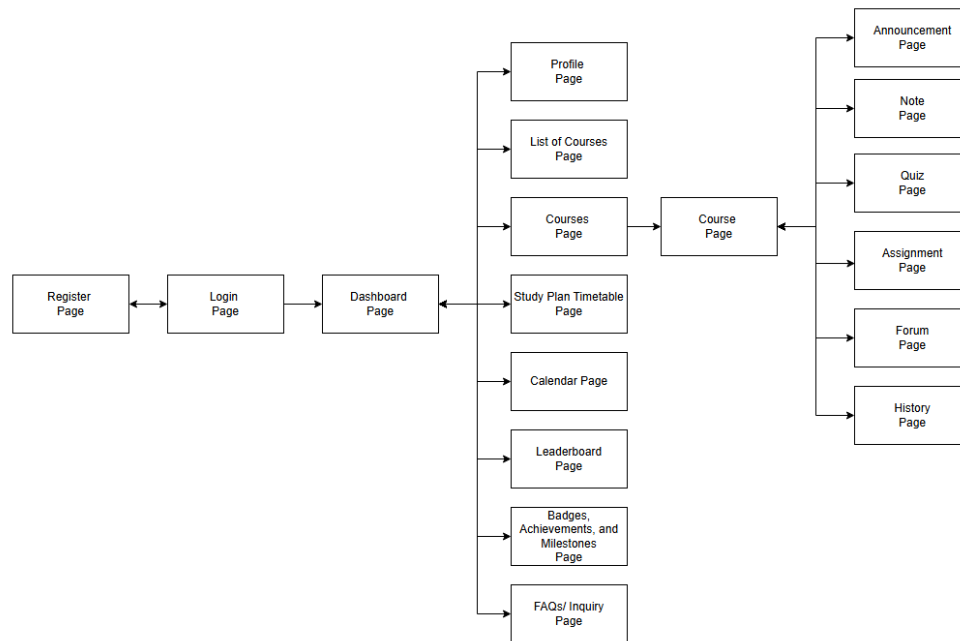
Figure 5.54:   Student Module Navigation Flowline.

5.5.2 Admin Module
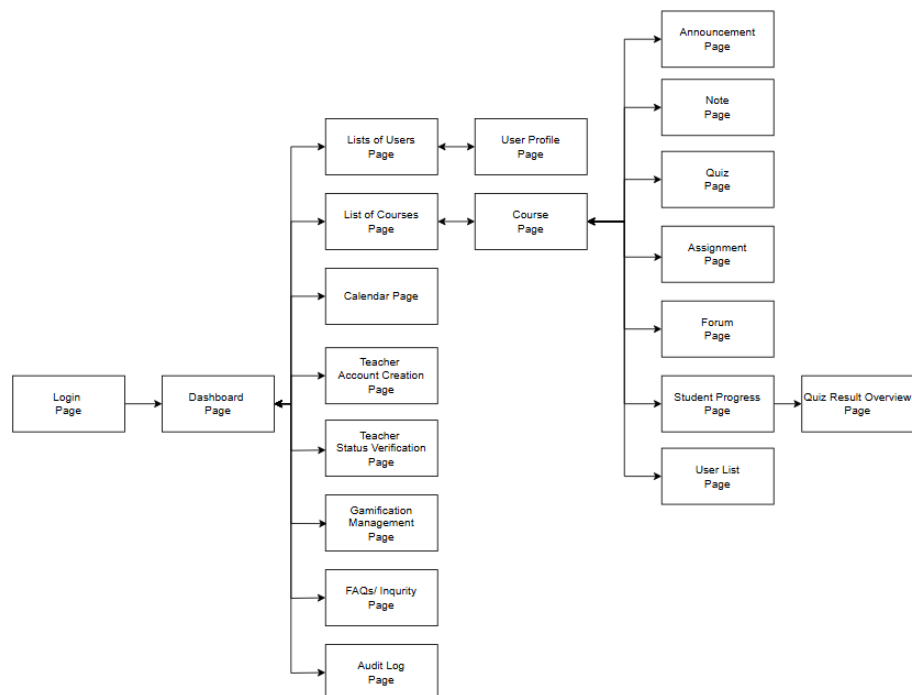
Figure 5.55:   Admin Module Navigation Flowline.

5.5.3   Teacher Module
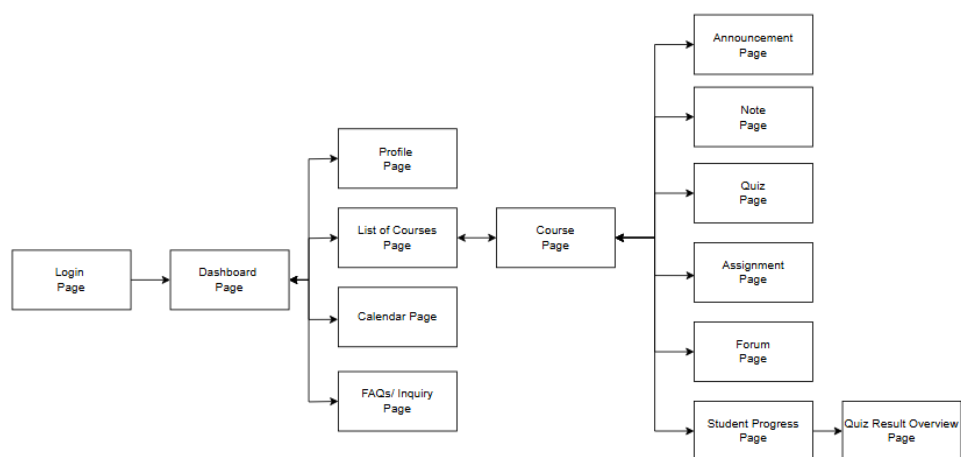
Figure 5.56:   Teacher Module Navigation Flowline.

CHAPTER 6

SYSTEM IMPLEMENTATION

6.1   Introduction

This section explains the development of both the front end and the back end. The design of the user interface is included to provide an overview of the layout and interaction flow within the web application. For back end development, the discussion includes the logic of implementing real-time broadcasting for notifications and forums, as well as automated task scheduling. Besides, the integration of the AI Study Planner into the web application is also outlined.

6.2   Front-End Development

The front end of the project is developed by combining both React components and Laravel Blade templates. This provides flexibility for the Blade to handle server-side rendering for layouts and views, while React is used to implement dynamic and interactive user interfaces. For building React components, Reactstrap is utilized to simplify the development by providing pre-styled elements such as navigation bars, modals, alerts, and forms. This is to ensure a consistent and responsive design throughout the web application. The detailed design of the user interface is shown in the following section.

6.2.1   General Access and System Pages

The student can register for an account by entering their name, username, email, and password.
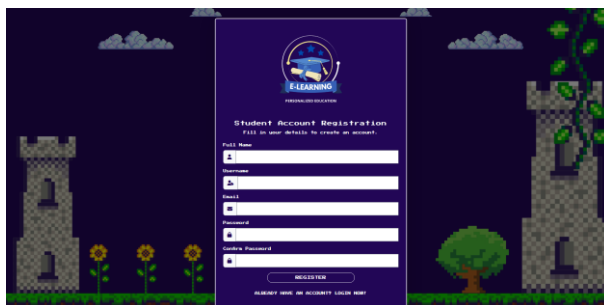
Figure 6.1: Account Registration Page.

All users can log in the web application with email and password.
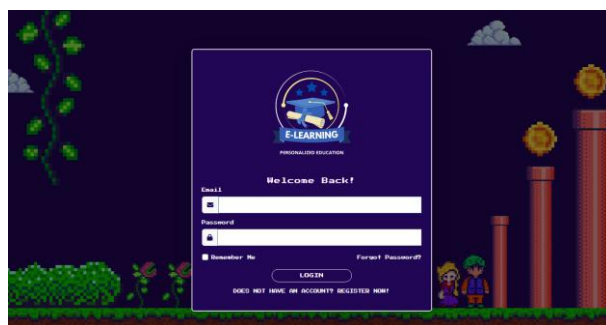
Figure 6.2: Login Page.

The alert message displays either a success or an error after performing certain actions by users.

Figure 6.3: Alert Message.

All users will receive real-time notifications about updates.
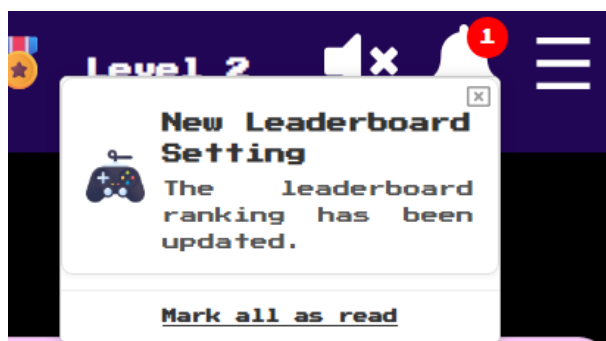
Figure 6.4: Notification Panel.

All users can access the calendar page to view the upcoming deadlines of the courses involved.
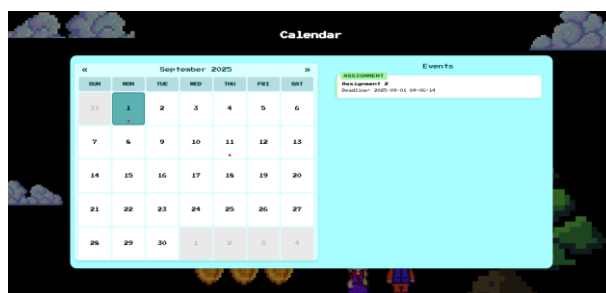
Figure 6.5: Calendar Page.

The footer contains a pop-up modal displaying the privacy policy and terms and conditions for all users.
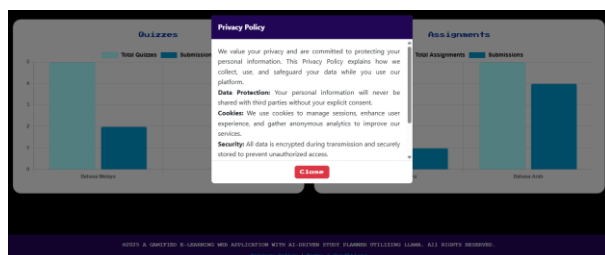
Figure 6.6: Pop-Up Modal.

The error handling pages are included for all users to manage 403, 404, and 500 errors.

Figure 6.7: Error Handling Page.
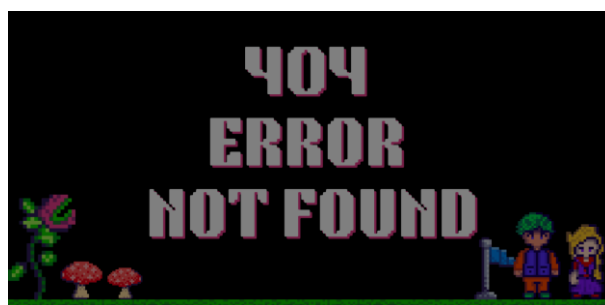
Figure 6.8: Error Handling Page.
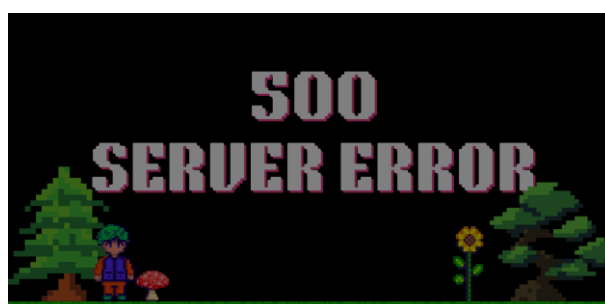
Figure 6.9: Error Handling Page.

6.2.2 Student Module

After a student logs in successfully, they will be directed to the dashboard. The dashboard first displays a welcome message which is followed by a summary section showing the total courses enrolled, quiz and assignments completion rate, badges earned, milestones achieved, and points to the next level.
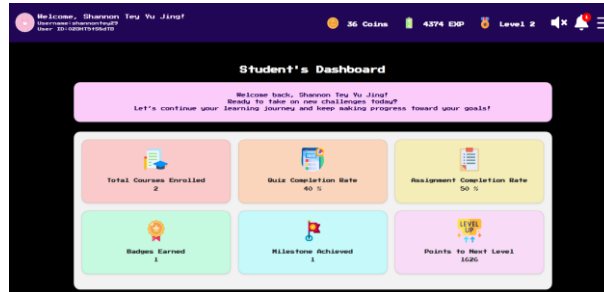
Figure 6.10:   Student Dashboard Page.

Below the summary, the dashboard includes the to-do items distribution and the total number of quizzes and assignments submitted for each course.
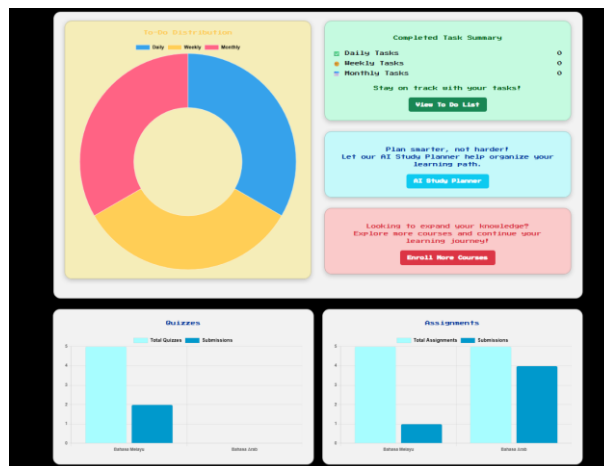
Figure 6.11:   Student Dashboard Page.

Then, the student can navigate through the navigation menu by clicking on the icon at the top right corner.
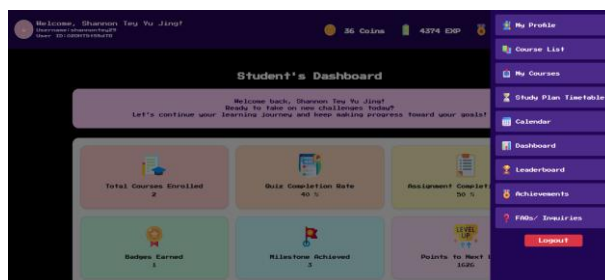
Figure 6.12:   Student Navigation Menu.

The student can view and update account information in the "My Profile" page.
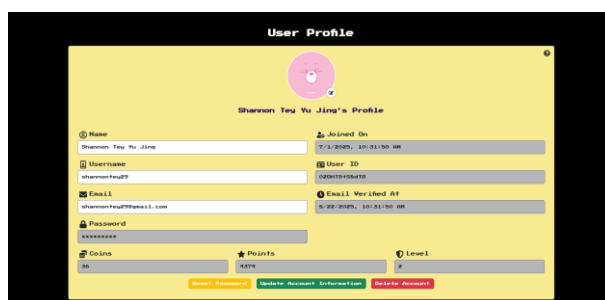
Figure 6.13:   Student Profile Page.

The student can view the list of available courses in the "Course List" page.
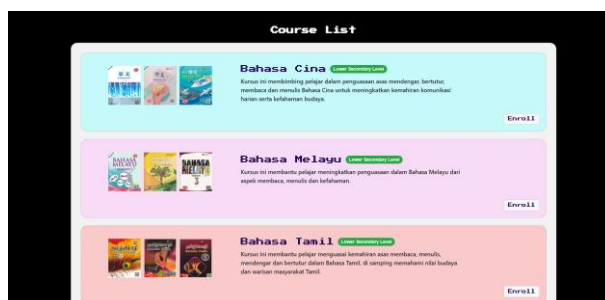
Figure 6.14:   Student Course List Page.

The student can enroll in a course and view it in the "My Course" page.

Figure 6.15:   Student Course Page.

The student can view the list of course announcements.
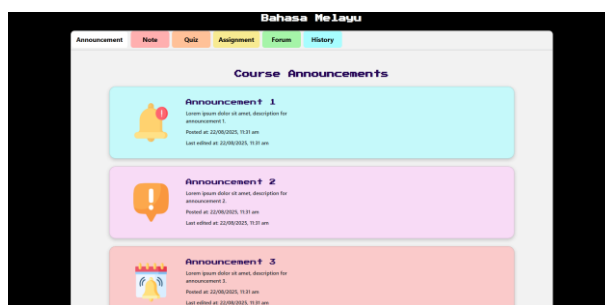
Figure 6.16:   Course Announcements Page.

The student can view the list of course notes and download them.

Figure 6.17:   Course Notes Page.

The student can view the list of course quizzes, access them, and submit answers.

Figure 6.18:   Course Quizzes Page.
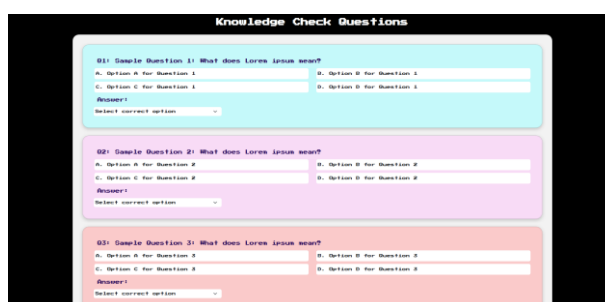
Figure 6.19:   Quiz Details Page.

The student can view and submit course assignments.

Figure 6.20:   Course Assignment Page.

The student can participate in the course forum by starting a new discussion or replying to a message to communicate and interact with teachers and peers in real-time.

Figure 6.21:   Course Forum Page.

The student can view the course history which includes the submission histories with results, returned marked copy, and feedback from teachers.

Figure 6.22:   Course History Page.

The student can review the quiz result after submission.
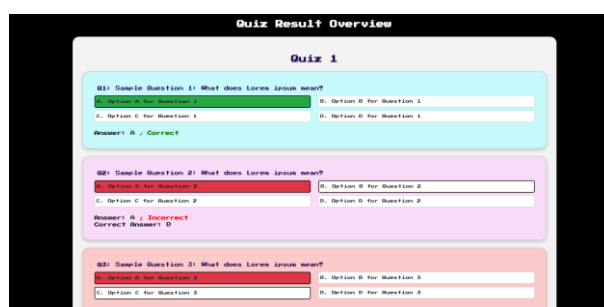
Figure 6.23:   Quiz Result Overview Page.

The student can view and access the study plan timetable in the "Study Plan Timetable" page. They can edit the timetable according to the school schedule. Then, the student updates the subject rankings by selecting a subject and entering the corresponding mark. The student is recommended to fill in at least four desired revision sessions. Finally, the student can generate a new study plan timetable powered by AI.

Figure 6.24:   Study Plan Timetable Page.

Figure 6.25:   Study Plan Timetable Page.

The student can add or delete to-do list items, categorize them as daily, weekly, or monthly, and update them upon completion.
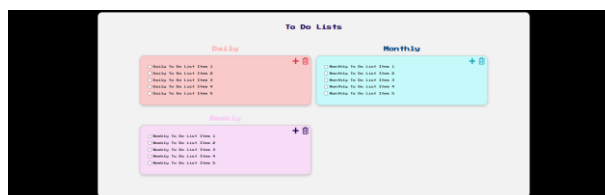
Figure 6.26:   Students To Do Lists.

The student can access the leaderboard in the "Leaderboard" page to view the current ranking.

Figure 6.27:   Student Leaderboard Page.

Below the leaderboard, it displays the daily missions to be completed and a motivation message for the student.

Figure 6.28:   Daily Mission and Motivation Message Section.

The student can view their achievements badges and milestones showing the achievement and date earned in the "Achievement" page.

Figure 6.29:   Student Achievement Page.

The student can view the frequently asked questions in the "FAQs/ Inquiry" page to look for answers to the commonly asked questions. If this does not solve their problems, they can submit an inquiry ticket to be further contacted.
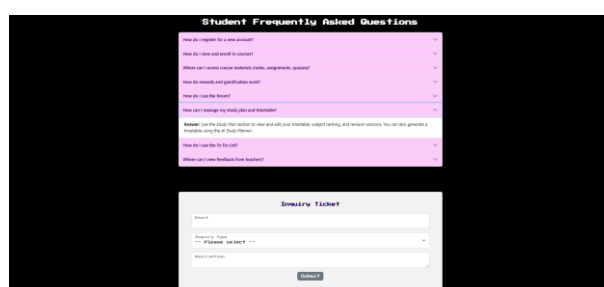
Figure 6.30:   Student FAQs/ Inquiry Page.

6.2.3   Admin Module

After an admin logs in successfully, they will be directed to the dashboard. The dashboard first displays a welcome message which is followed by a section showing the insights about the user account registration.
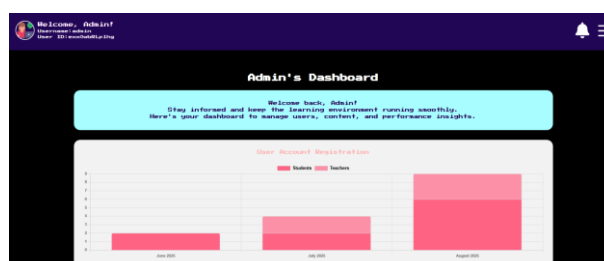
Figure 6.31:   Admin Dashboard Page.

Then, there will be a section displaying the help desk ticket status.
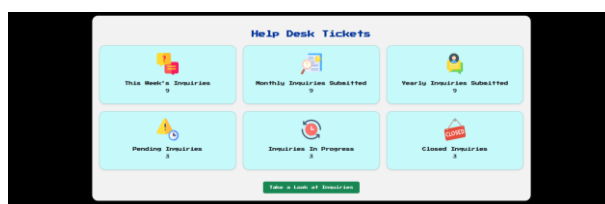
Figure 6.32:   Admin Dashboard Page.

Besides, there is a section showing the summary of teacher and student accounts, followed by a bar graph displaying the number of participants in each course.

Figure 6.33:   Admin Dashboard Page.

The admin can navigate through the navigation menu by clicking on the icon at the top right corner.

Figure 6.34:   Admin Navigation Menu.

The admin can search for users in the "All Users" page.

Figure 6.35:   All Users Page.

Then, the admin can view the details of the searched user and update their account information.
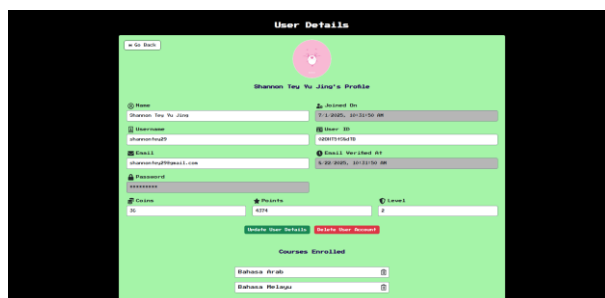
Figure 6.36:   User Details Page.

The admin can register an account for the teacher by entering the full name, username, email, and password in the "Open Teacher Account" page.
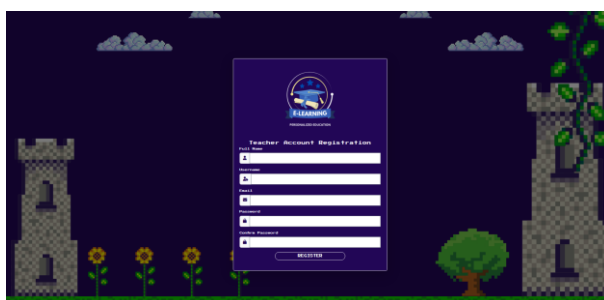
Figure 6.37:   Open Teacher Account Page.

The admin can view the list of teachers for status verification, review the submitted documents, and update their status.

Figure 6.38:   Status Verification Page.

The admin can manage gamification elements in the "Gamification Management" page. Admin can view a list of experience to level mappings, add new levels, update the leaderboard type, configure for daily missions, configure achievement badges, and milestones.
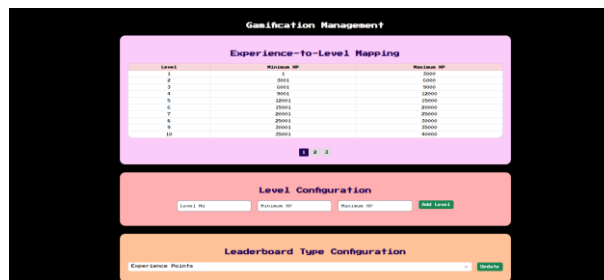
Figure 6.39:   Admin Gamification Management Page.

Figure 6.40:   Admin Gamification Management Page.
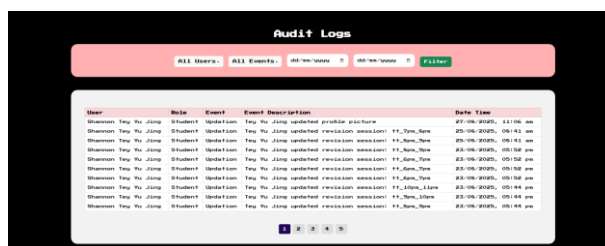
Figure 6.41:   Admin Gamification Management Page.

The admin can view the list of user inquiries in the "User Inquiries" page. Admin can update the user inquiries status from time to time.

Figure 6.42:   User Inquiries Page.

The admin can filter and view the list of audit logs showing the system activities in the "Audit Logs" page.

Figure 6.43:   Admin Audit Logs Page.

6.2.4   Teacher Module

After a teacher logs in successfully, they will be directed to the dashboard. The dashboard first displays a welcome message which is followed by a section showing the summary for a course assigned. Then, it displays the submissions for each quiz and assignment.

Figure 6.44:   Teacher Dashboard Page.
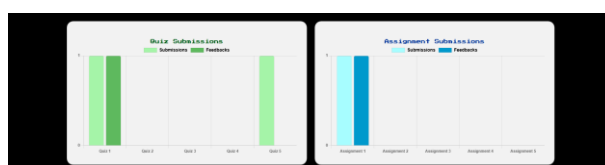
Figure 6.45:   Teacher Dashboard Page.

The teacher can navigate through the navigation menu by clicking on the icon at the top right corner.

Figure 6.46:   Teacher Navigation Menu.

The teacher can view and update their account information in the "My Profile" page. Teachers with unverified status can submit documents for verification.

Figure 6.47: Teacher Profile Page.

The teacher can view the frequently asked questions in the "FAQs/ Inquiry" page to look for answers to the commonly asked questions. If this does not solve their problems, they can submit an inquiry ticket to be further contacted.
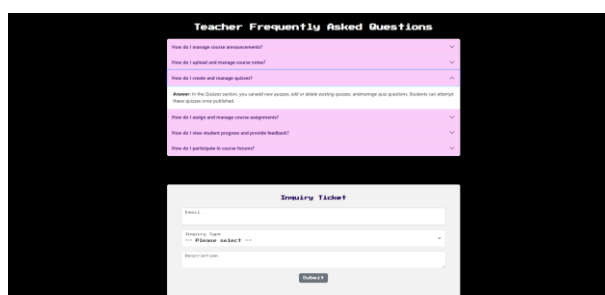
Figure 6.48: Teacher FAQs/ Inquiry Page.

6.2.5 Admin and Teacher Module

The admin can manage courses by adding, deleting, or updating them in the "All Courses" page.

Figure 6.49: All Courses Page.

The admin and teacher can manage course announcements by adding, deleting, or updating them.

Figure 6.50:   Course Announcement Page.

The admin and teacher can manage course notes by adding, deleting, or updating them.

Figure 6.51:   Course Note Page.

The admin and teacher can manage course quizzes by adding, deleting, or updating them. They are also able to design quiz questions, set rewards for submission, and define deadlines.
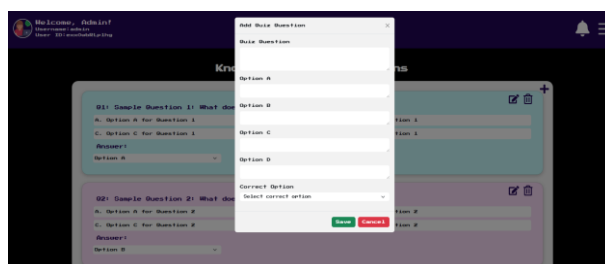
Figure 6.52:   Quiz Details Page.

The admin and teacher can manage course assignments by adding, deleting, or updating them. They are also able to upload the assignment documents, set rewards for submission, and define deadlines.
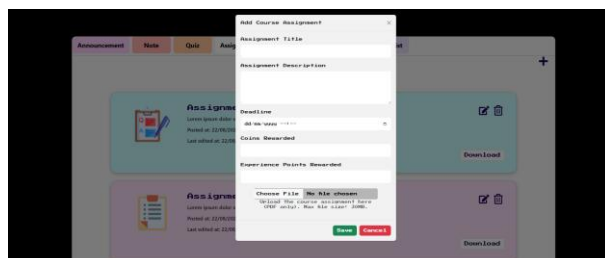
Figure 6.53:　　Course Assignment Page.

The admin and teacher can participate in real-time course forum discussions by posting or replying, and managing the forum content when necessary.
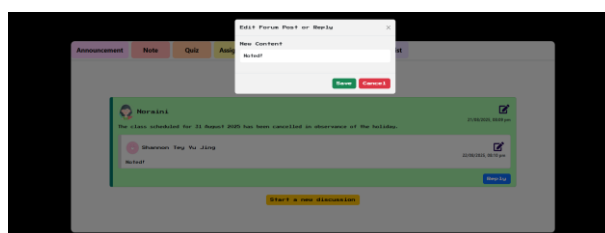
Figure 6.54:　　Course Forum Page.

The admin and teacher can view and access student progress by viewing their quiz and assignment submissions, quiz results, marking their submission, and providing personalized feedback.
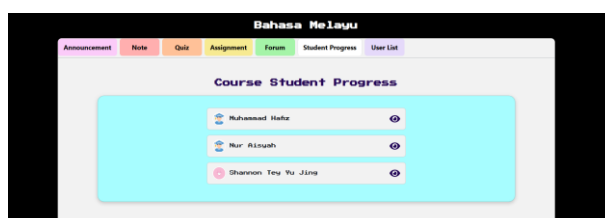
Figure 6.55:　　Course Student Progress Page.

The admin can manage the course participants by adding or removing users from the course.

Figure 6.56: Course User List Page.

6.3 Back-End Development

The backend of the project is developed using the Laravel PHP framework by following the Model-View-Controller (MVC) architecture. The backend implementation covers three aspects which include the standard development, real-time broadcasting, and automated task scheduling.

6.3.1 Real-Time Notifications

```php
class NewNotificationEvent implements ShouldBroadcast
{
    use Dispatchable, InteractsWithSockets, SerializesModels;

    public $userId;
    public $notification;

    public function __construct($userId, $notification)
    {
        $this->userId = $userId;
        $this->notification = $notification;
    }

    public function broadcastOn()
    {
        return new PrivateChannel('user.' . $this->userId);
    }

    public function broadcastWith()
    {
        return [
            'title' => $this->notification->noti_title,
            'message' => $this->notification->noti_message,
            'type' => $this->notification->noti_type,
            'created_at' => $this->notification->created_at->toDateTimeString(),
        ];
    }

    public function broadcastAs()
    {
        return 'new.notification';
    }
}
```

Figure 6.57: Laravel Broadcasting for New Notifications.

The NewNotificationEvent broadcasts personalized notifications privately to individual users. This event is used to handle real-time notifications for all users

within the web application. The $userId is the recipient of the notification while the $notification contains the notification content. The constructor will store the target user and notification details. Then, the event will be sent to a private channel (user.{id}) in which only the specific user receives the message. In this case, the real-time notifications for events like quiz deadlines, assignment updates, and course announcements will be pushed directly to individual users.

6.3.2   Real-Time Course Forum Updates

```php
class ForumPostCreated implements ShouldBroadcast
{
    use Dispatchable, InteractsWithSockets, SerializesModels;

    public $forum_post;

    public function __construct(ForumPost $forumPost)
    {
        $this->forum_post = $forumPost->load('user');
    }

    public function broadcastOn()
    {
        return new Channel('forum.' . $this->forum_post->forum_id);
    }

    public function broadcastAs()
    {
        return 'ForumPostCreated';
    }
}
```

Figure 6.58:   Laravel Broadcasting for Forum Posts.

The ForumPostCreated event is used to handle real-time forum updates by implementing ShouldBroadcast. This indicates that the event will be broadcasted via WebSockets. The $forum_post will store the relevant forum post along with the related user information. The constructor will load the newly created forum post and attach the user who created it. Then, the channel is defined as forum.{forum_id} so that only users subscribed to that forum channel will receive the update. In this case, when a student or teacher posts in the forum, all participants in that forum channel is able to see the post immediately without refreshing the page.

6.3.3   Automated Task Scheduling

```php
protected function schedule(Schedule $schedule)
{
    $schedule->command('todos:clear-old')->daily();
    $schedule->command('daily:check')->dailyAt('23:59');
}
```

Figure 6.59:   Laravel Task Scheduling.

Laravel's scheduling system is used to automate two routine tasks. In the implementation, the todos:clear-old command is scheduled to run daily to automatically remove outdated or completed to-do items from the database. Secondly, the daily:check command is set to run every day at 11:59 pm to perform end-of-day checks to track students in completing the daily missions.

6.4   AI Study Planner Development

The AI study planner is developed by integrating a large language model (LLM) into the web application to generate a study plan timetable for students. In this project, the LLaMA 3.1 model is primarily used, while the Qwen 2.5 model is also integrated for comparative performance evaluation presented in accuracy percentage, which will be discussed further in Chapter 7.4.
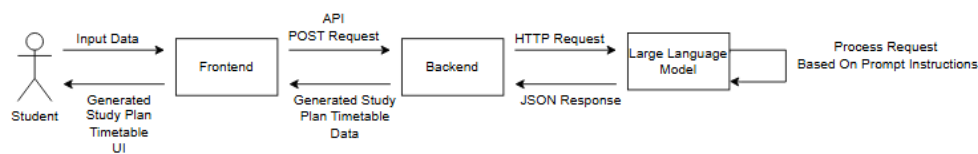
Figure 6.60:   Workflow of AI Study Planner Development.

Firstly, the student enters the required inputs that include the subjects, marks, and available revision time slots through the frontend interface. The frontend then sends the collected data via an API POST request to the backend server. The backend constructs a structured prompt and sends an HTTP request to the LLM for processing. The LLM processes the request based on the prompt instructions and returns a JSON response to the backend. The backend validates the response and stores it inside the database. Then, the processed study plan timetable data is returned to the frontend to be rendered as an interactive study plan timetable for the student to view and manage.

CHAPTER 7

SYSTEM TESTING

7.1 Introduction

This chapter presents the testing and evaluation activities carried out for the web application. It covers unit testing, performance evaluation of the LLaMA and Qwen-based AI Study Planner based on five criteria using the Weighted Scoring Model, integration testing, user acceptance testing (UAT), and a user satisfaction survey using the System Usability Scale (SUS). For each type of testing, the corresponding test cases and results are documented in order to assess the web application's correctness, performance, usability, and effectiveness.

7.2 Unit Testing

The unit testing is conducted by covering 14 submodules to validate all key functionalities for all three users. A total of 154 unit test cases are executed following the test cases as attached in Appendix B, with none of them reporting failure. This confirms that the web application meets the expected behavior and functional requirements. The following is a summary of the unit testing results.

Table 7.1: The Summary of Unit Testing.

Module	SubModule	Test Case Start	Test Case End	Total Unit Test Cases	Total Passed Unit Test Cases
All	Profile and Account Management	UT-M1-TC001	UT-M1-TC028	28	28
	Dashboard and Analytics	UT-M2-TC001	UT-M2-TC002	2	2

	Notifications	UT-M3-TC001	UT-M3-TC004	4	4
	Calendar and Deadline Tracking	UT-M4-TC001	UT-M4-TC002	2	2
Student	Course Management, Assessment, and Performance Tracking	UT-M5-TC001	UT-M5-TC013	13	13
	Gamification and Motivation	UT-M6-TC001	UT-M6-TC006	6	6
	Communication and Interaction	UT-M7-TC001	UT-M7-TC004	4	4
	AI-Powered Personalized Learning	UT-M8-TC001	UT-M8-TC012	12	12
Admin	User Account and Role Management	UT-M9-TC001	UT-M9-TC007	7	7
	Course and Content Moderation	UT-M10-TC001	UT-M10-TC030	30	30
	System Support	UT-M11-TC001	UT-M11-TC006	6	6
	Gamification Configuration	UT-M12-TC001	UT-M12-TC007	7	7
Teacher	Course Management	UT-M13-TC001	UT-M13-TC024	24	24

Admin and Teacher	Teacher-Student Interaction and Engagement	UT-M14-TC001	UT-M14-TC009	9	9
			Total	154	154

7.3 Integration Testing

After the unit testing, integration testing is conducted to validate that all modules can work correctly when combined. The testing focuses on verifying the interactions between the frontend, backend, and database to ensure that the data flows seamlessly through the web application. It is performed using Postman to test all API endpoints with the documentation provided in Appendix C. A total of 110 API endpoints were tested, and all passed successfully.

Table 7.2:   The Summary of Integration Testing.

Controller	Total API Endpoints	Total Passed API Endpoints
Admin Controller	16	16
Announcement Controller	4	4
Assignment Controller	5	5
Calendar Controller	2	2
Course Controller	7	7
Dashboard Controller	11	11
Forum Controller	5	5
Game Controller	18	18
Note Controller	4	4
Notification Controller	3	3
Register User Controller	2	2
Student Progress Controller	8	8
Study Planner Controller	7	7
Quiz Controller	10	10
User Controller	8	8
Total	110	110

7.4 Performance Evaluation of LLaMA and Qwen-based AI Study Planner

An evaluation is carried out to measure and compare the performance of two fine-tuned large language models, LLaMA 3.1 and Qwen 2.5 in generating personalized study plan timetables. There are five defined criteria, and each generated study plan timetable was scored with the results presented as accuracy percentages.

7.4.1 Data Collection and Input Design

A prompt template is designed to guide the large language models in generating structured and valid outputs in JSON format. The prompt acts as a framework in conditioning the model to follow specific rules rather than relying on its default generative behavior. The template defined the constraints, formatting, and logic for the study plan timetable generation, including the mandatory use of all available study slots, frequency requirements based on subject scores, coverage of all listed subjects, and strict JSON output formatting.

Two key input components for the AI study planner are the student's subject rankings with corresponding marks and the study time slots available across the week. Each of the subjects is represented by a pair of values which includes the subject name and the student's mark. The list of subject rankings determines the level of difficulty for each subject, forming the basis for prioritization. In this case, the subjects with lower marks are classified as challenging and are expected to receive more study slots, while subjects with higher marks are assigned fewer slots. This is to ensure the alignment between input data and the AI's allocation strategy.

Both the prompt and the input data are fixed and transformed into a standardized input format. This standardization is to ensure that LLaMA 3.1 and Qwen 2.5 receive identical input phrasing to generate study plan timetables under identical conditions. This approach is to minimize bias and enables the comparison to focus on the models' reasoning and scheduling capabilities rather than variations in inputs.

7.4.2   Experimental Setup

Two large language models, LLaMA 3.1 and Qwen 2.5 are selected for comparison. Generally, the output generated by large language models is non-deterministic, meaning that the same input can result in slightly different outputs (Song et al., 2024). By repeating each input multiple times, the effect of randomness can be reduced to provide a more reliable average performance score. However, fewer runs may not be sufficient to capture variability, while too many iterations would not significantly improve reliability after a certain point. Thus, each test input (a list of subjects with their corresponding marks) was executed 20 times per model. Additionally, all experiments are conducted under a controlled environment with identical hardware and software configurations.

7.4.3   Output Sampling

Each generated study plan timetable will be validated against a predefined JSON schema to ensure its correctness and consistency. Then, the validated JSON objects are stored in the database that can be queried, retrieved, and analyzed for evaluation.

7.4.4   Performance Evaluation Criteria Based on the Weighted Scoring Model

The generated study plan timetables are assessed using five key criteria designed to measure the performance of the large language models by following the Weighted Scoring Model. According to Gonzalez de Villaumbrosia (2025), this model prioritizes criteria by assigning a numerical score to each of the predefined criteria based on its relative importance. Then, the overall score for each criterion is calculated as the sum of the scores multiplied by the respective weights. The table below shows the evaluation criteria together with their weightage.

Table 7.3: Performance Evaluation Framework for LLM-Generated Study Plan Timetable.

Performance Evaluation Criteria	Weightage
Prioritization of Challenging Subjects	0.1
Score-To-Frequency Match	0.4
Subject Coverage	0.2
Slot Fill Rate	0.2
Daily Subject Variation	0.1

There are five evaluation criteria defined which include prioritization of challenging subjects, score-to-frequency match, subject coverage, slot fill rate, and daily subject variation, as these factors influence the effectiveness of a study plan timetable.

Firstly, the score-to-frequency match (0.4) has the highest weightage to determine whether the subjects are allocated in balance based on student performance to make sure that weaker subjects have more time slots. It is the most important factor as it reflects the primary goal of aligning study effort with performance targets.

Besides, the subject coverage (0.2) is to ensure that all listed subjects are included in the generated study plan timetable. The slot fill rate (0.2) is the degree to which all available study slots are being utilized without leaving gaps. These two factors are to ensure efficiency and completeness of a generated study plan timetable.

The prioritization of challenging subjects (0.1) is the extent to which the model allocates more slots to difficult subjects in which the student has lower scores. Also, the daily subject variation (0.1) is the diversity of subjects scheduled on each day to promote balanced learning.

Finally, the overall accuracy for each generated study plan timetable is then computed as the sum of the criterion scores multiplied by their respective weightages with the following equation:

Overall Accurracy $= (0.1 \times S_{\text{Prioritization of Challenging Subject}}) + (0.4 \times S_{\text{Score-To-Frequency Match}}) + (0.2 \times S_{\text{Subject Coverage}}) + (0.2 \times S_{\text{Slot Fill Rate}}) + (0.1 \times S_{\text{Daily Subject Variation}})$

Where:

$S_{\text{Prioritization of Challenging Subject}}$ = Score for Prioritization of Challenging Subject

$S_{\text{Score-To-Frequency Match}}$ = Score for Score-To-Frequency Match

$S_{\text{Subject Coverage}}$ = Score for Subject Coverage

$S_{\text{Slot Fill Rate}}$ = Score for Slot Fill Rate

$S_{\text{Daily Subject Variation}}$ = Score for Daily Subject Variation

7.4.5   Model Comparison and Analysis

For each of the models, 20 accuracy scores will be produced. Based on these, three aggregate metrics are calculated which include the accuracy distribution across the five evaluation criteria, mean accuracy, and variability. Both LLaMA 3.1 and Qwen 2.5 models are then compared directly on these aggregated metrics to determine their performance.

7.4.6   Results and Discussion

The performance evaluation results for each run of both LLaMA 3.1 and Qwen 2.5 are presented across 20 runs, as shown in Tables 7.4 and 7.5.

Table 7.4:   Results of Five Evaluation Criteria for LLaMA 3.1 and Qwen 2.5 (1-10 Runs).

Run	Prioritization of Challenging Subjects		Score-to-Frequency Match		Subject Coverage		Slot Fill Rate		Daily Subject Variation		Accuracy	
	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen
1	Yes	No	91.70%	74.10%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	96.70%	79.60%
2	Yes	No	91.70%	75.00%	100.00%	100.00%	89.00%	100.00%	100.00%	100.00%	94.50%	80.00%
3	Yes	No	88.90%	71.10%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	95.60%	78.40%
4	Yes	Yes	84.40%	44.40%	100.00%	44.40%	100.00%	100.00%	100.00%	100.00%	93.80%	66.70%
5	Yes	No	88.90%	80.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	95.60%	82.00%
6	Yes	No	92.60%	63.00%	100.00%	100.00%	75.00%	100.00%	100.00%	100.00%	92.00%	75.20%
7	Yes	Yes	94.40%	77.80%	100.00%	89.00%	100.00%	54.00%	100.00%	100.00%	97.80%	79.60%
8	Yes	Yes	88.90%	100.00%	100.00%	100.00%	100.00%	50.00%	100.00%	100.00%	95.60%	90.00%
9	Yes	Yes	100.00%	66.70%	100.00%	100.00%	50.00%	100.00%	100.00%	100.00%	90.00%	86.70%
10	Yes	No	94.40%	63.00%	100.00%	89.00%	100.00%	100.00%	100.00%	100.00%	97.80%	73.00%

Table 7.5: Results of Five Evaluation Criteria for LLaMA 3.1 and Qwen 2.5 (11-20 Runs).

Run	Prioritization of Challenging Subjects		Score-to-Frequency Match		Subject Coverage		Slot Fill Rate		Daily Subject Variation		Accuracy	
	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen	LLaMA	Qwen
11	Yes	Yes	96.30%	69.40%	100.00%	100.00%	79.00%	100.00%	100.00%	100.00%	94.20%	87.80%
12	Yes	No	88.90%	64.80%	100.00%	89.00%	100.00%	100.00%	100.00%	100.00%	95.60%	73.70%
13	Yes	Yes	84.40%	66.70%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	93.80%	86.70%
14	Yes	Yes	88.90%	75.60%	100.00%	89.00%	71.00%	100.00%	100.00%	100.00%	89.80%	88.00%
15	Yes	No	94.40%	62.20%	100.00%	89.00%	100.00%	100.00%	100.00%	100.00%	97.80%	72.70%
16	Yes	No	88.90%	80.60%	100.00%	62.20%	100.00%	100.00%	100.00%	100.00%	95.60%	74.90%
17	Yes	No	88.90%	63.00%	100.00%	100.00%	61.00%	100.00%	100.00%	100.00%	87.70%	75.20%
18	Yes	Yes	85.20%	97.20%	100.00%	100.00%	50.00%	100.00%	100.00%	100.00%	98.90%	83.10%
19	Yes	No	94.40%	66.70%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	97.80%	76.70%
20	Yes	No	88.90%	59.30%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	95.60%	73.70%
Avg.	100.00%	81.82%	90.76%	71.03%	100.00%	92.58%	88.75%	95.20%	100.00%	100.00%	94.81%	79.19%
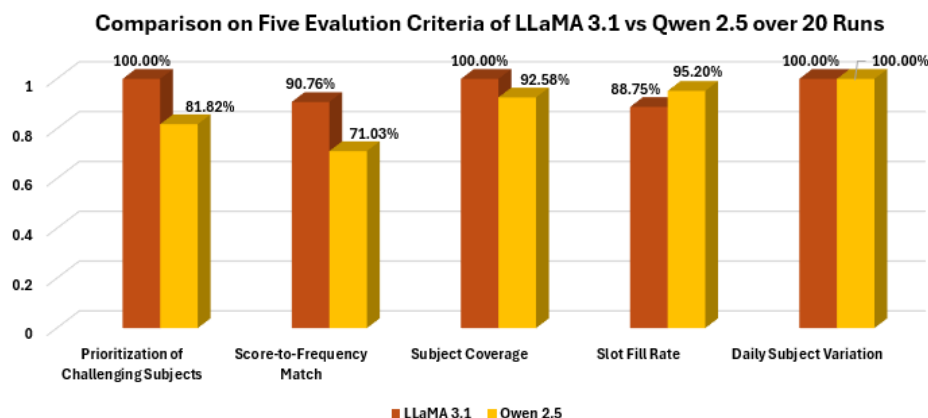
Figure 7.1: The Comparison Results of LLaMA 3.1 and Qwen 2.5 Based on
Five Evaluation Criteria over 20 Runs.

The evaluation results in Figure 7.1 show that the LLaMA 3.1 model
outperforms the Qwen 2.5 model in most of the measured evaluation criteria in
generating a study plan timetable. LLaMA achieved a perfect score of 100% in
the prioritization of challenging subjects compared to Qwen's 81.82%. This
indicates that LLaMA is more effective at identifying and focusing on the areas
where students struggle the most. Besides, for the score-to-frequency match,
LLaMA scored 90.76% while Qwen scored 71.03%. This reflects that LLaMA
is stronger in allocating study time based on student performance. In terms of
subject coverage, LLaMA achieved 100% with a slightly higher score than
Qwen's 92.58% to ensure that all subjects are consistently included in the
generated study plan timetable. However, the slot fill rate was slightly higher
for Qwen with 95.20% than for LLaMA with 88.75%. This outlines that Qwen
is more efficient at utilizing available time slots. Both models performed equally
well in daily subject variation, each scoring 100%, showing that the balanced
subjects are distributed throughout the week. Overall, the LLaMA 3.1 model
demonstrates better performance in most evaluation criteria, especially in
addressing challenging subjects and aligning study time based on student needs,
while the Qwen 2.5 model shows strength in maximizing time slot usage.
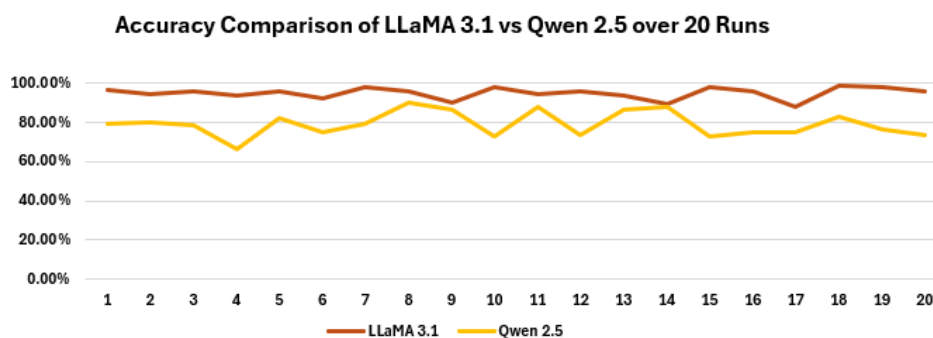
Figure 7.2: The Summary of Accuracy Comparison of LLaMA 3.1 vs Qwen 2.5 over 20 Runs.

The accuracy is compared to determine which model can produce more correct and reliable output. The result of the accuracy comparison over 20 runs in Figure 7.2 shows that the LLaMA 3.1 model has a better overall performance than the Qwen 2.5 model in generating a study plan timetable. LLaMA achieved accurate scores between 87.70% and 98.90% with an average of 94.81%. For Qwen, the accuracy ranged from 66.70% to 90% with an average of 79.19%. This shows that Qwen's performance is less stable and consistent, as it frequently drops below 80%. In contrast, LLaMA maintains a consistent high accuracy that never falls below 87.70%. Importantly, LLaMA's accuracy is continuously higher than Qwen across all 20 runs. These results highlight that the LLaMA 3.1 model is more reliable in generating an accurate study plan timetable, whereas the Qwen 2.5 model demonstrates greater variability and lower overall effectiveness.
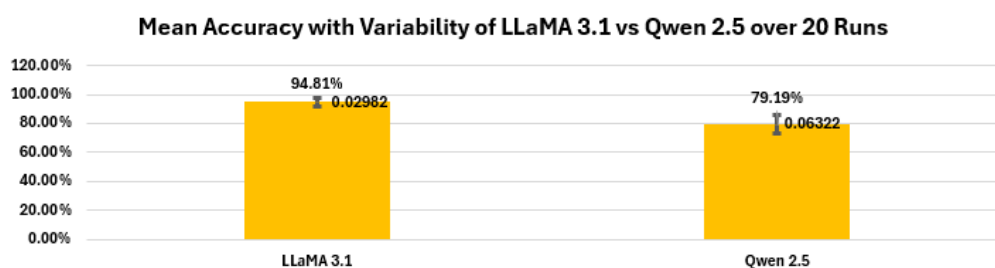
Figure 7.3: The Summary of Mean Accuracy with Variability of LLaMA 3.1 vs Qwen 2.5 over 20 Runs.

Mean accuracy with variability is used to evaluate the average model performance and consistency across multiple runs. The summary of mean accuracy with variability over 20 runs in Figure 7.3 shows that the LLaMA 3.1 model has a higher mean accuracy of 94.81% compared to the Qwen 2.5 model of 79.19%. LLaMA also demonstrates a greater stability in generating a new study plan timetable with a lower standard deviation of 0.02982 compared to Qwen's 0.06322. This shows that LLaMA can deliver an accurate result with outputs that are more consistent across repeated runs, in which the results from Qwen fluctuate in this case.

The reasons for the LLaMA 3.1 model to have a better performance in generating study plan timetables than the Qwen 2.5 model can be due to their differences in design and training focus. LLaMA is designed by Meta AI for instruction following, reasoning, and multi-step tasks (Ollama, 2024). It is optimized to generate structured outputs and perform well on tasks that require logical sequence and prioritization. In contrast, Qwen is the Chinese generative artificial intelligence developed by Alibaba Cloud (Sallam et al., 2025). According to Joshi (2025), Qwen is designed and trained for Chinese-language tasks and general-purpose text generation. It has better capabilities in coding and mathematics. According to multiple English benchmarks, LLaM 3.1 scores higher in MMLU-EM (88.6), MMLU-Redux (86.2), MMLU-Pro (73.3), IF-Eval (86), and SimpleQA (17.1). In Chinese tasks, Qwen 2.5 excels in CLUEWSC (91.4) and C-Eval (86.1). From the benchmark studies, LLaMA 3.1 tends to perform better in English tasks, especially when it comes to reasoning and understanding complex questions. Qwen 2.5, on the other hand, demonstrates stronger performance in Chinese and multilingual tasks (Aydin et al., 2025). Thus, in this case, Qwen is less suitable for tasks that require precise prioritization, scheduling, and multi-step reasoning in English contexts where structured logic is highly involved.

In conclusion, based on the Weighted Scoring Model, the LLaMA 3.1 model generated a more accurate and consistent study plan timetable compared to the Qwen 2.5 model after prompt-engineering. It is shown by its superiority in prioritizing challenging subjects, score-to-frequency match, and subject coverage. The LLaMA 3.1 model achieves an average accuracy of 94.81%, with

a maximum accuracy of 98.90%. This makes the LLaMA 3.1 model more suitable for integration into the gamified e-learning web application.

7.5   User Acceptance Testing (UAT)

User Acceptance Testing (UAT) is carried out with 17 secondary school students, 2 secondary teachers, and 1 representative for the administrator to ensure that the web application meets the requirements and expectations of the end users. During UAT, the selected participants are asked to perform a series of predefined tasks shown in the tables below, together with the results. The individual test results for each participant are provided in Appendix D.

Table 7.6:   The Summary of UAT Results by Students.

UAT ID	Module	Test Scenario	Total Executed	Total Passed
UAT-001	Profile and Account Management	1. Register a new account. 2. Log in with valid credentials. 3. Update account information. 4. Log out.	17	17
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	17	17
UAT-003	Notifications	1. Access and view notifications in real time.	17	17
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	17	17
UAT-005	Course Management, Assessment, and	1. Access and view the list of available courses. 2. Enroll in a new course. 3. Access and view the enrolled course.	17	17

	Performance Tracking	4. View and download course notes. 5. View and submit course quizzes. 6. View, download, and submit course assignments. 7. View course history.		
UAT-006	Gamification and Motivation	1. Access and view the gamification status. 2. Gain rewards. 3. Access and view the leaderboard. 4. Access and view the daily missions. 5. Access and view the achievement badges and milestones.	17	17
UAT-007	Communication and Interaction	1. Access and view feedback from submission. 2. Access and view forum posts. 3. Submit a post or reply in the forum.	17	17
UAT-008	AI-Powered Personalized Learning	1. Access and view the study plan timetable. 2. Edit the study plan timetable. 3. Access and view the subject ranking. 4. Edit the subject ranking.	17	17

		5. Access and view the revision session.		
		6. Edit the revision session.		
		7. Generate a study plan timetable.		
		8 Access and view the to-do list items.		
		9. Add, update, and delete the to-do list items.		

Table 7.7:   The Summary of UAT Results by Administrator.

UAT ID	Module	Test Scenario	Total Executed	Total Passed
UAT-009	Profile and Account Management	1. Log in with valid credentials. 2. Register an account for a teacher. 3. Log out.	1	1
UAT-010	Dashboard and Analytics	1. Access and view the dashboard.	1	1
UAT-011	Notifications	1. Access and view notifications in real time.	1	1
UAT-012	Calendar and Deadline Tracking	1. Access and view the calendar.	1	1
UAT-013	User Account and Role Management	1. Global search for a user. 2. Access and view user details. 3. Update user details. 4. Delete user account.	1	1

		5. Manage users' course participation. 6. Access and view the list of teachers to be verified. 7. Update teacher's verification status.		
UAT-014	Course and Content Moderation	1. Access and view the list of all courses. 2. Add, update, and delete courses. 3. Manage course notes. 4. Manage course announcements. 5. Manage course quizzes. 6. Manage course assignments. 7. Manage course participants.	1	1
UAT-015	System Support	1. Access and view the list of user inquiries. 2. Update the user inquiry ticket. 3. Access and view the audit logs based on filters.	1	1
UAT-016	Gamification Configuration	1. Access and view the gamification management page. 2. Configure for gamification elements.	1	1
UAT-017	Teacher-Student Interaction	1. Access and view the list of students. 2. Access and view students' progress.	1	1

	and Engagement	3. Submit feedback and return student submission. 4. Access and view forum posts. 5. Submit a post or reply in the forum. 6. Edit forum content.		

Table 7.8:   The Summary of UAT Results by Teachers.

UAT ID	Module	Test Scenario	Total Executed	Total Passed
UAT-018	Profile and Account Management	1. Log in with valid credentials. 2. Update account information. 3. Submit the document for status verification. 4. Log out.	2	2
UAT-019	Dashboard and Analytics	1. Access and view the dashboard.	2	2
UAT-020	Notifications	1. Access and view notifications in real time.	2	2
UAT-021	Calendar and Deadline Tracking	1. Access and view the calendar.	2	2
UAT-022	Course Management	1. Access and view the list of courses assigned. 2. Manage the course notes. 3. Manage the course announcements. 4. Manage the course quizzes.	2	2

		5. Manage the course assignments.		
UAT-023	Teacher-Student Interaction and Engagement	1. Access and view the list of students. 2. Access and view students' progress. 3. Submit feedback and return student submission. 4. Access and view forum posts. 5. Submit a post or reply in the forum. 6. Edit forum content.	2	2

7.6   Usability Testing

Usability testing is conducted to evaluate the effectiveness and efficiency of users using the web application. The main goal is to measure the user satisfaction, ease of use, and the overall experience with the web application. It is important in providing valuable insights into the web application and identifying areas for future improvements.

7.6.1   User Satisfaction Survey

The following is the user satisfaction survey template adopted from the System Usability Scale (SUS) introduced by John Brooke in 1986. It consists of 10 items to assess user perceptions of the web application's usability. Each of the items is rated on a five-point scale, from Strongly Disagree (1 point) to Strongly Agree (5 points).

Table 7.9: User Satisfaction Survey Template Based on the System Usability Scale (SUS) (Brooke, J., 1986).

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.					
2. I found this web application was overly complex.					
3. I felt that the web application was easy to use.					
4. I think I would need help from a technical person to use this web application.					
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.					
6. I felt there was too much inconsistency in this web application.					
7. I think it would be easy for most people to learn how to use this web application.					

8. I thought the overall experience using this web application was awkward.					
9. I felt confident while using the web application.					
10. I needed to learn a lot of things before I could start using this web application.					

7.6.2   User Satisfaction Survey Result

The individual survey results for each participant is attached in Appendix E. The results of the survey are tabulated, and the individual user ratings for each of the ten items are shown. A total score is calculated for each user which is then converted into a System Usability Scale (SUS) score. Then, the average SUS score across all users is calculated and obtained to provide an overall measure of the web application's usability.

Table 7.10: The Summary of User Satisfaction Survey Result.

User	Rating for Each Item										SUS Survey Score
	1	2	3	4	5	6	7	8	9	10	
1	4	1	4	1	4	2	5	1	4	1	87.5
2	4	1	4	1	5	1	4	2	4	2	85
3	4	1	4	1	4	1	4	2	4	2	82.5
4	4	1	4	1	5	1	4	1	5	2	90
5	4	2	4	1	4	1	5	1	4	2	85
6	5	2	4	1	4	1	5	1	4	1	90
7	4	1	5	1	4	1	4	1	4	2	85
8	4	1	4	2	4	2	5	1	4	2	82.5

9	4	1	5	2	4	1	5	1	4	1	90
10	4	1	4	1	5	2	5	1	4	2	87.5
11	4	2	4	1	4	2	4	1	4	1	82.5
12	4	1	4	1	5	1	5	1	4	1	92.5
13	5	1	4	1	4	2	4	1	4	1	87.5
14	4	2	4	1	4	2	4	1	5	2	82.5
15	4	1	4	1	3	1	4	1	4	1	85
16	4	2	4	1	4	1	4	2	4	1	82.5
17	4	1	4	1	4	2	5	1	4	2	85
18	4	1	4	2	4	2	4	1	4	1	82.5
19	4	1	4	1	3	2	5	1	5	2	85
20	4	1	4	1	3	1	5	2	5	1	87.5
Average System Usability Scale (SUS) Survey Score											85.875

The average System Usability Scale (SUS) survey score obtained for the web application is 85.875. According to Smyk (2020), it falls under the category of "excellent" based on the SUS acceptability score interpretation. Generally, a SUS score of above 68 can be interpreted as above average, while a score of above 80 indicates that users perceive the system as highly usable and effective. Thus, the result suggests that the participants found the web application easy to learn and use with minimal complexity, consistent in allowing them to complete tasks with the least confusion, reliable, and supportive of their goals which made it suitable for integration into their study routine. Besides, the high score also indicates a strong user acceptance level where the users are likely to adopt and continue using it in real scenarios. This is because the web application demonstrates not only functional adequacy but also positive user experiences which include satisfaction, clarity, and effectiveness.

CHAPTER 8

CONCLUSION

8.1 Conclusion

A gamified e-learning web application with an AI-driven study planner utilizing LLaMA has been successfully developed for secondary students. The web application tackled the main issues identified in traditional and existing e-learning systems which are the lack of gamification, absence of personalized study plan timetables, limited progress tracking, and insufficient social interaction with feedback mechanisms. It provides extrinsic motivation and improves teacher-student engagement by incorporating experience points, coins, rewards, badges, and progress bars.

Secondly, the integrated AI study planner is evaluated based on five predefined criteria by using a Weighted Scoring Model to compare the accuracy of LLaMA 3.1 and Qwen 2.5 in generating personalized study plan timetables. After prompt-engineering, LLaMA 3.1 outperformed Qwen 2.5 by achieving the highest recorded accuracy of 98.90% with an average accuracy of 94.81%. This highlights the effectiveness of LLaMA in producing more reliable and structured study plan timetables to support secondary students for a consistent and productive study routine.

Besides, the System Usability Scale (SUS) evaluation produced an average score of 85.875 which falls under the "excellent" category. The score obtained confirms that the users found the web application easy to use and supportive of their learning needs effectively. The high usability rating also indicates that the web application's ability to integrate gamification, progress tracking, and engagement features effectively ensures a positive user experience.

In conclusion, the project achieved its objectives by delivering an e-learning solution that not only enhances motivation through gamification but also leverages AI to provide personalized study planning. The deliverable shows how gamification elements and AI-driven personalization can be combined to make an e-learning platform more effective, engaging, and learner-centered.

8.2   Project Limitations and Future Recommendations

Although the web application integrates experience points, rewards, badges, and progress bars, the coins feature is currently not linked to any tangible usage, such as redeeming items in an e-shop. Without practical value, the motivational impact of coins on students can be limited. The future enhancement could include developing an in-app marketplace that allows students to redeem earned coins to unlock avatars, access premium notes, or reattempt quizzes.

The AI study planner powered by LLaMA 3.1 demonstrates a high accuracy in generating a structured study plan timetable. However, the performance is based on well-prepared datasets. The model's generalizability to larger and diverse student populations has not been fully validated. Also, the model is limited by the scope of personalization. This is because the current study plan timetables focus on subject scheduling and time allocation. For deeper personalization such as adapting to individual learning styles, cognitive load, and mood is not yet included. Thus, it should extend personalization to consider factors such as students' performance history, attention span, and difficulty levels. In this case, the AI study planner should dynamically adapt by continuously monitoring student progress and automatically updating the study plan timetable in real time.

From the technical perspective, the web application has only been tested in a controlled environment with a small dataset. In this case, the scalability to support many concurrent users has not been fully assessed. Additionally, the dependency on an external AI model can introduce extra computational costs and resource requirements which could be challenging in real-world deployments. So, the web application performance must be optimized to support large-scale deployments with many users concurrently and the cloud-based deployment can be used to manage AI resource demands more efficiently.

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APPENDICES

Appendix A: Google Form-Based Questionnaire

Secondary Education with Gamified E-Learning

Hello! I am Tey Yu Jing, a Year 3 Semester 2 student at Universiti Tunku Abdul Rahman (UTAR), pursuing a Bachelor's degree in Software Engineering. I am conducting a study on how a **gamified e-learning website** can enhance **secondary school students'** academic performance through personalized learning.

This survey takes around 5 minutes and your responses will remain confidential. Thank you in advance.

* Indicates required question

General Information

1. What is your age? *   ⊙ Dropdown

   Mark only one oval.

   ◯ 13-15

   ◯ 16-18

   ◯ 19 and above

2. What is your current education level? *

   Mark only one oval.

   ◯ Lower Secondary (Form 1 - Form 3)

   ◯ Upper Secondary (Form 4 - Form 5)

   ◯ SPM Graduate

   ◯ Pre-University (e.g., STPM, Matriculation, Foundation, A-Levels, Diploma, etc.)

   ◯ Undergraduate (Bachelor's Degree Student)

   ◯ Other: _____

3. Which year did you or will you take SPM exam? *   ⊙ Dropdown

Mark only one oval.

◯ Before 2020

◯ 2021

◯ 2022

◯ 2023

◯ 2024

◯ 2025

◯ 2026 or Later

4. Do you have access to the Internet? *

Mark only one oval.

◯ Yes

◯ No

5. What device(s) do you own? *

Check all that apply.

☐ Smartphone

☐ Tablet

☐ Laptop

☐ Desktop computer

☐ Smart TV

☐ Gaming console

☐ None

☐ Other: _____

6. Do you have any special learning needs (e.g., Dyslexia, ADHD)? *

Mark only one oval.

◯ Yes

◯ No

Academic Performance

7. How many A's did you obtain or expect to obtain in SPM? *   ⊙ Dropdown

Mark only one oval.

◯ 0

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

◯ 6

◯ 7

◯ 8

◯ 9

◯ 10

◯ 10+

8. Which subject(s) do you find most challenging? *

   Check all that apply.

   ☐ Bahasa Melayu
   ☐ Bahasa Inggeris
   ☐ Sejarah
   ☐ Pendidikan Moral
   ☐ Sains/ Science
   ☐ Biologi/ Biology
   ☐ Fizik/ Physics
   ☐ Kimia/ Chemistry
   ☐ Prinsip Akaun
   ☐ Matematik/ Mathematics
   ☐ Matematik Tambahan/ Addtional Mathematics
   ☐ Other: _____

9. On a scale of 1-5, how motivated are you to study? *

   Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very motivated

Learning Preferences

10. How many hours per day do you typically spend studying? *   ⊙ Dropdown

   Mark only one oval.

   ◯ Less than 1 hour
   ◯ 1 - 2 hours
   ◯ 3 - 4 hours
   ◯ More than 4 hours

11. How do you usually study? *

Check all that apply.

- ☐ Reading textbooks
- ☐ Watching videos
- ☐ Doing exercise/ past year papers
- ☐ Studying with friends
- ☐ Using online learning platforms

12. Do you prefer structured lessons or self-paced learning? *   ⊙ Dropdown

Mark only one oval.

- ◯ Structured (like school schedules)
- ◯ Self-paced (learn at my own speed)
- ◯ A mix of both

13. Do you study alone or in a group? *   ⊙ Dropdown

Mark only one oval.

- ◯ Alone
- ◯ Group
- ◯ Both, depending on the subject

14. Have you used any online learning plarforms before? *
(Select all that apply)

Check all that apply.

☐ Coursera

☐ FrogLearn

☐ Google Classroom

☐ Kahoot!

☐ SPMflix

☐ No, I have never used any online learning platforms

☐ Other: _____

15. Have you experienced online classes before? *

Mark only one oval.

◯ Yes, I have attended full-time online classes.

◯ Yes, I have attended hybrid (both online and physical) classes.

◯ No, I have never attended online classes.

16. What challenges do you face when studying online? *

Check all that apply.

☐ Lack of motivation

☐ Difficulty staying focused

☐ No proper study schedule

☐ Hard to find good learning resources

☐ Not enough interaction with teachers

17. What features would make online learning more engaging for you? *

Check all that apply.

☐ Gamification (points, badges, levels, ranking)
☐ Personalized dashboard and progress tracking
☐ Interactive quizzes and lessons
☐ Challenges with friends
☐ AI-generated study plans
☐ Teacher feedback on quizzes and assignments
☐ Discussion forums and Q&A sessions
☐ Achievement-based certifications upon course completion
☐ Other: _____

18. Do you have a study plan? *

Mark only one oval.

⬭ Yes
⬭ No

19. Would you be interested in an AI-generated personalized study plan for your learning? *

Mark only one oval.

⬭ Yes
⬭ No
⬭ Maybe

Gamification and Motivation

20. Do you prefer competitive (leaderboards) or non-competitive (personal progress) gamification? * ⊙ Dropdown

Mark only one oval.

⚪ Competitive

⚪ Non-Competitive

⚪ Both

21. Would you be more motivated to study if learning felt like a game? *

Mark only one oval.

⚪ Yes

⚪ No

⚪ Maybe

22. Which gamification elements do you like the most? *

Check all that apply.

☐ Earning points and rewards for completing tasks

☐ Competing with friends on a leaderboard

☐ Unlocking new levels and achievements

☐ Getting recommended topics based on my interest

☐ Progress bar showing how close I am to the next level

☐ Weekly missions and challenges

☐ Receiving achievement badges for reaching milestones

☐ Other: _____

23. Would you be interested in trying a gamified e-learning website for your studies? *

Mark only one oval.

○ Yes

○ No

○ Maybe

Addtional Feedback

24. What features do you wish an online learning platform had but haven't found yet?
(Select all that apply) *

Check all that apply.

☐ Discussion forums

☐ Real-time tutor assistance

☐ Dashboard to track progress

☐ AI-generated personalized study plans

☐ Interactive quizzes and challenges

☐ Gamified rewards and leaderboards

☐ Other: _____

25. Any suggestions for improving online learning experiences? *

_____
_____
_____
_____
_____

Appendix B: Unit Test Cases

Module: Profile and Account Management						
Description: To test the register functionality by the student.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M1-TC001	The student registers with valid details.	1. Open the Register page. 2. Enter a valid full name, username, email, password, and confirm password. 3. Click the "Register" button.	Full name: Shannon Tey Username: shannontey29 Email: shannontey29@ gmail.com Password: Styj0303@ Confirm password: Styj0303@	The account is created successfully and the student is redirected to the login page.	As expected.	Pass

UT-M1-TC002	The student registers with an existing username.	1. Open the Register page. 2. Enter a valid full name, email, password, and confirm password. 3. Enter an existing username. 4. Click the "Register" button.	Follows UT-M1-TC001, but using an existing username.	Error message displayed: "The username has already been taken."	As expected.	Pass
UT-M1-TC003	The student registers with an existing email.	1. Open the Register page. 2. Enter a valid full name, username, password, and confirm password. 3. Enter an existing email. 4. Click the "Register" button.	Follows UT-M1-TC001, but using an existing email.	Error message displayed: "The email has already been taken."	As expected.	Pass
UT-M1-TC004	The student registers with mismatched passwords.	1. Open the Register page. 2. Enter a valid full name, username, and email. 3. Enter different values for the password and confirm password. 4. Click the "Register" button.	Follows UT-M1-TC001, but the confirm password is Styj0202@.	Error message displayed: "The password confirmation does not match."	As expected.	Pass

UT-M1-TC005	The student registers with a weak password.	1. Open the Register page. 2. Enter a valid full name, username, and email. 3. Enter a short password and without special characters. 4. Click the "Register" button.	Follows UT-M1-TC001, but the password is 123.	Error message displayed: "The password must be at least 8 characters." and "The password format is invalid."	As expected.	Pass
UT-M1-TC006	The student registers with an invalid email format.	1. Open the Register page. 2. Enter a valid full name, username, and email. 3. Enter an invalid email. 4. Click the "Register" button	Follows UT-M1-TC001, but the email is shanonteygmail.	Error message displayed: "Invalid email format".	As expected.	Pass
UT-M1-TC007	The student registers with empty fields.	1. Open the Register page. 2. Leave one or more fields empty. 3. Click the "Register" button.	All fields left empty.	Error message displayed: "All fields are required".	As expected.	Pass

Module: Profile and Account Management
Description: To test the register functionality by the admin for the teacher.
Created and Executed By: Tey Yu Jing

Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M1-TC008	The admin registers a teacher with valid details.	1. Log in as an admin. 2. Navigate to the Open Teacher Account page. 3. Fill all fields correctly. 4. Click the "Register" button.	Full name: Tey Yu Jing Username: teyyj29 Email: teyyj29@ gmail.com Password: Tyj0303@ Confirm password: Ttyj0303@	The teacher account is created and appears in the teacher list.	As expected.	Pass
UT-M1-TC009	The admin registers a teacher with an existing username.	Follows UT-M1-TC008, but enter a duplicate username.	Follows UT-M1-TC008, but using an existing username.	Error message displayed: "The	As expected.	Pass

				username has already been taken."		
UT-M1-TC010	The admin registers a teacher with an existing email.	Follows UT-M1-TC008, but enter a duplicate email.	Follows UT-M1-TC008, but using an existing email.	Error message displayed: "The email has already been taken."	As expected.	Pass
UT-M1-TC011	The admin registers a teacher with mismatched passwords.	Follows UT-M1-TC008, but enter different values for password and confirm password.	Follows UT-M1-TC008, but the confirm password is Tyj0202@.	Error message displayed: "The password confirmation does not match."	As expected.	Pass
UT-M1-TC012	The admin registers a teacher with a weak password.	Follows UT-M1-TC008, but enter a short password without special characters.	Follows UT-M1-TC008, but the password is 123.	Error message displayed: "The password must be at least 8 characters."	As expected.	Pass

				and "The password format is invalid."		
UT-M1-TC013	The admin registers a teacher with an invalid email format.	Follows UT-M1-TC008, but enter an invalid email.	Follows UT-M1-TC008, but the email is tyj29gmail.	Error message displayed: "Invalid email format".	As expected.	Pass
UT-M1-TC014	The admin registers a teacher with empty fields.	Follows UT-M1-TC008, but leave one or more fields empty.	All fields left empty.	Error message displayed: "All fields are required".	As expected.	Pass
UT-M1-TC015	To verify the default role for the teacher.	1. The admin creates a new teacher account.	In the users table, the role is teacher.	The teacher's role is set correctly in the system.	As expected.	Pass

Module: Profile and Account Management
Description: To test the login and logout functionalities for all users.
Created and Executed By: Tey Yu Jing

Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M1-TC016	The users log in to the web application.	1. Open the login page. 2. Enter valid registered credentials. 3. Click the "Login" button.	User account logged in.	The user is logged in successfully and directed to the welcome page.	As expected.	Pass
UT-M1-TC017	The users log out of the web application.	1. Click the navigation menu icon. 2. Click the "Logout" button.	User account logged in.	The user is logged out successfully and redirected to the login page.	As expected.	Pass

Module: Profile and Account Management						
Description: To test the view and update personal information functionalities for all users.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M1-TC018	The user views personal information.	1. Log in with valid credentials. 2. Navigate to the My Profile page.	User account logged in.	The page displays the current user's details.	As expected.	Pass

UT-M1-TC019	The user updates personal information with valid data.	Follows UT-M1-TC018. 1. Change full name/ username/ email. 2. Click the "Update Account Information" button.	Full name: Shannon Tey Yu Jing	The personal information is updated successfully with new data reflected immediately.	As expected.	Pass
UT-M1-TC020	The user updates personal information with an invalid email.	Follows UT-M1-TC018. 1. Enter an invalid email format. 2. Click the "Update Account Information" button.	Email: shannonteygmail	Error message displayed: "The email must be a valid email address."	As expected.	Pass
UT-M1-TC021	The user resets the password with valid input.	Follows UT-M1-TC018. 1. Click the "Reset Password" button. 2. Enter old password. 3. Enter the new password and confirm the password. 4. Click the "Yes" button.	Old password: Styj0303@ New password: Styj3030@ Confirm password: Styj3030@	The password is updated successfully.	As expected.	Pass

UT-M1-TC022	The user resets the password with an incorrect old password.	Follows UT-M1-TC018, but enter an incorrect old password.	Old password: Styj0202@	Error message displayed: "The old password is incorrect."	As expected.	Pass
UT-M1-TC023	The user resets the password with a mismatched confirmation.	Follows UT-M1-TC018. 1. Click the "Reset Password" button. 2. Enter old password. 3. Enter a new password and confirm password differently. 4. Click the "Yes" button.	Old password: Styj0303@ New password: Styj3030@ Confirm password: Styj0202@	Error message displayed: "The new passwords do not match."	As expected.	Pass
UT-M1-TC024	The user changes the profile picture with a valid file.	Follows UT-M1-TC018. 1. Click the "Edit Profile Picture" icon. 2. Upload a valid image. 3. Click the "Upload" button.	Profile picture: shannon_profile _pic.jpg	The profile picture is updated successfully with new data reflected immediately.	As expected.	Pass
UT-M1-TC025	The user changes the	Follows UT-M1-TC018.	Profile picture: shannon_profile	Error message displayed: "The	As expected.	Pass

	profile picture with an invalid file.	1. Click the "Edit Profile Picture" icon. 2. Upload an invalid image. 3. Click the "Upload" button.	_pic.pdf	profile picture failed to upload."		
UT-M1-TC026	The teacher submits the required document for status verification.	Follows UT-M1-TC018. 1. Click the "Verify Status" button. 2. Upload a valid file. 3. Click the "Upload" button.	Document: teacher1_doc.pdf	The document is uploaded successfully, and the verification status is updated to "Pending immediately.	As expected.	Pass
UT-M1-TC027	The teacher submits an invalid document for status verification.	Follows UT-M1-TC018. 1. Click the "Verify Status" button. 2. Upload an invalid file. 3. Click the "Upload" button.	Document: teacher1_doc.pptx	Error message displayed: "Upload failed. Please try again. "	As expected.	Pass

UT-M1-TC028	The user deletes the account.	Follows UT-M1-TC018. 1. Click the "Delete Account" button. 2. Click the "Yes" button.	User account logged in.	The user is redirected back to the login page with all data removed from the system.	As expected.	Pass

Module: Dashboard and Analytics						
Description: To test the view dashboard and analytics functionalities for all users.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M2-TC001	The user is redirected to the dashboard after login.	1. Log in with valid credentials.	User account logged in.	The user is redirected automatically to the dashboard.	As expected.	Pass
UT-M2-TC002	The user accesses the dashboard via	1. Log in with valid credentials. 2. Open the navigation menu. 3. Navigate to the Dashboard page.	User account logged in.	The dashboard is loaded correctly.	As expected.	Pass.

	the navigation menu.					

Module: Notifications						
Description: To test the general notification functionalities for all users.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M3-TC001	The user receives the notification in real-time.	1. Log in with valid credentials. 2. A notification event is triggered. 3. Observe the notification indicator.	User account logged in.	The notification appears instantly, indicated by the indicator on the top right of the bell icon.	As expected.	Pass
UT-M3-TC002	The user views the notification in the notification panel.	1. Log in with valid credentials. 2. Click on the bell icon.	User account with unread notifications.	All unread notifications appear instantly.	As expected.	Pass.

UT-M3-TC003	The user marks all notifications as read.	1. Log in with valid credentials. 2. Open the notification panel. 3. Click the "Mark all as read" button.	User account with unread notifications.	The indicator on the top right of the bell icon resets to zero.	As expected.	Pass
UT-M3-TC004	The user removes a single notification.	1. Log in with valid credentials. 2. Open the notification panel. 3. Click the "X" icon beside each single notification.	User account with unread notifications.	The indicator on the top right of the bell icon has reduced by one.	As expected.	Pass

Module: Calendar and Deadline Tracking						
Description: To test the calendar and deadline tracking functionalities for all users.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M4-TC001	The user views the calendar.	1. Log in with valid credentials. 2. Navigate to the "Calendar" page.	User account logged in.	The page displays the current month.	As expected.	Pass

UT-M4-TC002	The user views the event on a specific date.	Follows UT-M4-TC001. 1. Click on a specific date. .	User account logged in.	The list of events is displayed with the specific event name and the due date and time.	As expected.	Pass

Module: Course Management, Assessment, and Performance Tracking						
Description: To test the functionality of the course management, assessment, and performance tracking features for the students by verifying that all interactions within a course are correctly processed.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M5-TC001	The student views the list of courses available.	1. Log in with valid credentials. 2. Navigate to the Course List page.	Student account logged in.	The list of courses available is displayed.	As expected.	Pass
UT-M5-TC002	The student enrolls in a course.	Follows UT-M5-TC001. 1. Click the "Enroll" button.	Course: Maths	The student successfully enrolled in the	As expected.	Pass

			course. It is visible on the student's "My Courses" page.		
UT-M5-TC003	The student views the list of courses enrolled.	1. Log in with valid credentials. 2. Navigate to the My Courses page.	Student account with at least one course enrolled.	The list of courses enrolled is displayed.	As expected.	Pass
UT-M5-TC004	The student views the course details.	Follows UT-M5-TC003. 1. Click the "View Course" button.	Student account with at least one course enrolled.	The student is directed to the course detail page.	As expected.	Pass
UT-M5-TC005	The student views the course announcements.	Follows UT-M5-TC004. 1. Click the "Announcement" tab.	Student account with at least one course enrolled.	The list of course announcements is displayed.	As expected.	Pass
UT-M5-TC006	The student views the course notes.	Follows UT-M5-TC004. 1. Click the "Note" tab.	Student account with at least one course enrolled.	The list of course notes is displayed.	As expected.	Pass

UT-M5-TC007	The student downloads the course notes.	Follows UT-M5-TC006. 1. Click the "Download" button.	Downloaded note: Note1.pdf	The course note has been successfully downloaded to the device.	As expected.	Pass
UT-M5-TC008	The student views the course quizzes.	Follows UT-M5-TC004. 1. Click the "Quiz" tab.	Student account with at least one course enrolled.	The list of course quizzes is displayed.	As expected.	Pass
UT-M5-TC009	The student submits the answers for the quiz.	Follows UT-M5-TC008. 1. Click the "Attempt" button. 2. Select the correct options. 3. Click the "Save" button.	Student account with at least one course enrolled.	The answers are submitted successfully with a confirmation message. It is visible at the experience points and coins at the header.	As expected.	Pass

UT-M5-TC010	The student views the course assignments.	Follows UT-M5-TC004. 1. Click the "Assignment" tab.	Student account with at least one course enrolled.	The list of course assignments is displayed.	As expected.	Pass
UT-M5-TC011	The student downloads the course assignments.	Follows UT-M5-TC010. 1. Click the "Download" button.	Downloaded assignment: Assignment1.pdf	The course assignment has been successfully downloaded to the device.	As expected.	Pass
UT-M5-TC012	The student submits the course assignments.	Follows UT-M5-TC010. 1. Click the "Submit" button. 2. Upload a valid file. 3. Click the "Save" button.	Submitted assignment: Shannon_A1.pdf	The assignment is submitted successfully with a confirmation message. It is visible at the experience points and coins at the header.	As expected.	Pass

| UT-M5-TC013 | The student tracks submission history. | Follows UT-M5-TC004. 1. Click the "History" tab. | Student account with at least one course enrolled. | The list of course histories is displayed. | As expected. | Pass |

Module: Gamification and Motivation						
Description: To test the gamification and motivation functionalities for the students by validating that rewards are granted with data reflected immediately through visible progress and milestones.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M6-TC001	The student views the gamification status.	1. Log in with valid credentials.	Student account logged in.	The level, experience points, and coins are displayed at the header.	As expected.	Pass
UT-M6-TC002	The student submits a quiz	Follows UT-M5-TC009.	Student account with at least one course enrolled	The level, experience points, and coins are	As expected.	Pass

				updated successfully with new data reflected immediately. It is visible in the header.		
and gains rewards.			and an unsubmitted quiz.			
UT-M6-TC003	The student submits an assignment and gains rewards.	Follows UT-M5-TC012.	Student account with at least one course enrolled and an unsubmitted assignment.	The level, experience points, and coins are updated successfully with new data reflected immediately. It is visible in the header.	As expected.	Pass
UT-M6-TC004	The student views the leaderboard.	1. Log in with valid credentials. 2. Navigate to the Leaderboard page.		The leaderboard is displayed.	As expected.	Pass

| UT-M6-TC005 | The student views the daily missions. | 1. Log in with valid credentials. 2. Navigate to the Leaderboard page. 3. Navigate to the daily mission section. | Student account logged in. | The daily missions are displayed. | As expected. | Pass |
| UT-M6-TC006 | The student views the achievement badges and milestones. | 1. Log in with valid credentials. 2. Navigate to the Achievements page. | Student account logged in. | The list of a student's achievements is displayed. | As expected. | Pass |

Module: Communication and Interaction						
Description: To test the communication and interaction functionalities for the students to view teacher feedback and, access forum posts and replies, create new posts, and reply to existing posts.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status

UT-M7-TC001	The student views the feedback provided by the teacher.	UT-M5-TC013.	Student account logged in with submission histories.	The list of feedback for each submission is displayed.	As expected.	Pass
UT-M7-TC002	The student views the forum posts and replies.	Follows UT-M5-TC004. 1. Click the "Forum" tab.	Student account with at least one course enrolled.	The list of forum posts and replies is displayed.	As expected.	Pass
UT-M7-TC003	The student posts a post.	Follows UT-M7-TC002. 1. Click the "Start a new discussion" button. 2. Type in the message. 3. Click the "Send" button.	Post: Hi.	The post is posted successfully with new data reflected immediately. It is visible to all students and teachers from the same course.	As expected.	Pass

| UT-M7-TC004 | The student replies to a post. | Follows UT-M7-TC002. 1. Click the "Reply" button. 2. Type in the message. 3. Click the "Send" button. | Reply: Thank you. | The reply is posted successfully with new data reflected immediately. It is visible to all students and teachers from the same course. | As expected. | Pass |

Module: AI-Powered Personalized Learning						
Description: To test the functionality of viewing, updating, and generating a personalized study plan timetable for students.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M8-TC001	The student views the study plan timetable.	1. Log in with valid credentials. 2. Navigate to the Study Plan Timetable page. 3. Navigate to the timetable section.	Student account logged in.	The timetable is displayed.	As expected.	Pass

UT-M8-TC002	The student edits the study plan timetable.	Follows UT-M8-TC001. 1. Click the "Edit Timetable" button. 2. Navigate to the desired slot. 3. Select an event or subject. 4. Click the "Save Changes" button.	Monday 10 am: School	The timetable is updated successfully with a confirmation message and new data reflected immediately.	As expected.	Pass
UT-M8-TC003	The student views the subject ranking.	1. Log in with valid credentials. 2. Navigate to the Study Plan Timetable page. 3. Navigate to the subject ranking section.	Student account logged in.	The subject ranking is displayed.	As expected.	Pass
UT-M8-TC004	The student edits the subject ranking.	Follows UT-M8-TC003. 1. Select a subject. 2. Enter the mark. 3. Click the "Update" button.	Subject: Science Mark: 90	The subject ranking is updated successfully with a confirmation message and new	As expected.	Pass

				data reflected immediately.		
UT-M8-TC005	The student views the revision session.	1. Log in with valid credentials. 2. Navigate to the Study Plan Timetable page. 3. Navigate to the revision session section.	Student account logged in.	The revision session is displayed.	As expected.	Pass
UT-M8-TC006	The student edits the revision session.	Follows UT-M8-TC005. 1. Select the checkbox to mark the revision session.	Revision session: 3pm to 4pm.	The revision session is updated successfully with a confirmation message and new data reflected immediately.	As expected.	Pass
UT-M8-TC007	The student views the AI study planner generator.	1. Log in with valid credentials. 2. Navigate to the Study Plan Timetable page.	Student account logged in.	The AI Study Planner section is displayed.	As expected.	Pass

		3. Navigate to the AI Study Planner section.				
UT-M8-TC008	The student generates a study plan timetable.	Follows UT-M8-TC007. 1. Select an AI study planner. 2. Click the "Generate Study Plan Timetable" button.	Student account logged in.	The timetable is updated successfully with a confirmation message and new data reflected immediately.	As expected.	Pass
UT-M8-TC009	The student views the to-do list items.	1. Log in with valid credentials. 2. Navigate to the Study Plan Timetable page. 3. Navigate to the To Do Lists section.	Student account logged in.	The To Do Lists section is displayed.	As expected.	Pass
UT-M8-TC010	The student adds the to-do list item.	Follows UT-M8-TC009. 1. Click the add icon. 2. Enter to-do list item. 3. Click the "Add" button.	Weekly: Revision for Science CHAPTER 1 -3.	The to-do list item is added successfully with a confirmation	As expected.	Pass

				message and new data reflected immediately.		
UT-M8-TC011	The student edits the to-do list item.	Follows UT-M8-TC009. 1. Click the edit icon. 2. Select the checkbox to mark or unmark the to-do list item.	Weekly: Revision for Science CHAPTER 1 -4.	The to-do list item is updated successfully with a confirmation message and new data reflected immediately.	As expected.	Pass
UT-M8-TC012	The student deletes the to-do list item.	Follows UT-M8-TC009. 1. Click the delete icon. 2. Click the "Delete" button.	Student account logged in.	The to-do list item is deleted successfully with a confirmation message and new data reflected immediately.	As expected.	Pass

Module: User Account and Role Management						
Description: To test the user account and role management functionalities for the admins for searching, viewing, updating, deleting users, managing the course enrollment or assignment, and verifying teachers.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M9-TC001	The admin searches for a user.	1. Log in with valid credentials. 2. Navigate to the All Users page. 3. Type in a user name.	Search keyword: shan	The list of users with the globally searched name is displayed.	As expected.	Pass
UT-M9-TC002	The admin views the user details.	Follows UT-M9-TC001. 1. Click the "View Details" button.	User: Shannon Tey	The admin is directed to the user detail page.	As expected.	Pass
UT-M9-TC003	The admin updates user details.	Follows UT-M9-TC002. 1. Enter new user information. 2. Click the "Update User Details" button.	New email: st29@gmail.com	The user detail is updated successfully with new data reflected immediately.	As expected.	Pass

UT-M9-TC004	The admin deletes a user account.	Follows UT-M9-TC002. 1. Click the "Delete Account" button. 2. Click the "Yes" button.	Admin account logged in.	The user account is deleted successfully with new data reflected immediately.	As expected.	Pass
UT-M9-TC005	The admin removes a user from a course.	Follows UT-M9-TC002. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in with at least one user in the course.	The user is removed from the course successfully with new data reflected immediately.	As expected.	Pass
UT-M9-TC006	The admin views the list of teachers to be verified.	1. Log in with valid credentials. 2. Navigate to the Teacher Status Verification page.	Admin account logged in with at least one teacher with a pending status.	The list of teachers to be verified is displayed.	As expected.	Pass
UT-M9-TC007	The admin updates the teacher's status.	Follows UT-M9-TC006. 1. Click the download icon to review the document uploaded.	Admin account logged in.	The teacher's status is updated successfully with	As expected.	Pass

		2. Change the status.	Status: Pending	new data reflected		
		3. Click the "Verify" button.	to Verified	immediately.		
		4. Click the "Yes" button.				

Module: Course and Content Moderation						
Description: To test the course and content moderation functionalities for the admin in managing all aspects of courses.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M10-TC001	The admin views the list of all courses.	1. Log in with valid credentials. 2. Navigate to the All Courses page.	Admin account logged in.	The list of all courses is displayed.	As expected.	Pass
UT-M10-TC002	The admin adds a new course.	Follows UT-M10-TC001. 1. Click the add icon. 2. Enter course title and description. 3. Select course category. 4. Upload the course textbook image. 5. Click the "Save" button.	Title: Maths Description: This course is xxx. Category: Upper secondary	The new course is added successfully with new data reflected immediately.	As expected.	Pass

			Textbook 1: Maths_T4.jpg Textbook 2: Maths_T5.jpg			
UT-M10-TC003	The admin edits the course information.	Follows UT-M10-TC001. 1. Click the edit icon. 2. Enter new course title and description. 3. Select new course category. 4. Upload new course textbook image. 5. Click the "Save" button.	Title: Maths_edited Description: This course is xxx. Category: Upper secondary Textbook 1: Maths_T4.jpg Textbook 2: Maths_T5.jpg	The course information is updated successfully with new data reflected immediately	As expected.	Pass
UT-M10-TC004	The admins delete a course.	Follows UT-M10-TC001. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The course is deleted successfully with	As expected.	Pass

				new data reflected immediately.		
UT-M10-TC005	The admin views the course details.	Follows UT-M10-TC001. 1. Click the "View Course" button.	Admin account logged in.	The admin is directed to the course detail page.		
UT-M10-TC006	The admin views the course announcements.	Follows UT-M10-TC005. 1. Click the "Announcement" tab.	Admin account logged in.	The list of course announcements is displayed.	As expected.	Pass
UT-M10-TC007	The admin adds a course announcement.	Follows UT-M10-TC006. 1. Click the add icon. 2. Enter the announcement title and description. 3. Click the "Save" button.	Title: Announcement 1 Description: This is xxxx.	The course announcement is added successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC008	The admin edits a course announcement.	Follows UT-M10-TC006. 1. Click the edit icon.	Title: Announcement 1 (Edited)	The course announcement is updated	As expected.	Pass

		2. Enter the new announcement title and description. 3. Click the "Save" button.	Description: This is xxxx.	successfully with new data reflected immediately.		
UT-M10-TC009	The admins delete a course announcement.	Follows UT-M10-TC006. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The course announcement is deleted successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC010	The admin views the course notes.	Follows UT-M10-TC005. 1. Click the "Note" tab.	Admin account logged in.	The list of course notes is displayed.	As expected.	Pass
UT-M10-TC011	The admin downloads a course note.	Follows UT-M10-TC010. 1. Click the "Download" button.	Downloaded note: Note1.pdf	The course note has been successfully downloaded to the device.	As expected.	Pass
UT-M10-TC012	The admin adds a course note.	Follows UT-M10-TC010. 1. Click the add icon.	Title: Note 1	The course note is added successfully	As expected.	Pass

		2. Enter the note title and description. 3. Upload a valid file. 4. Click the "Save" button.	Description: This is xxx. File: Note1.pdf	with new data reflected immediately.		
UT-M10-TC013	The admin edits a course note.	Follows UT-M10-TC010. 1. Click the edit icon. 2. Enter the new note title and description. 3. Upload a new valid file. 4. Click the "Save" button.	Title: Note 1 (Edited) Description: This is xxx. File: Note1.pdf	The course note is updated successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC014	The admin deletes a course note.	Follows UT-M10-TC010. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The course note is deleted successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC015	The admin views the course quizzes.	Follows UT-M10-TC005. 1. Click the "Quiz" tab.	Admin account logged in.	The list of course quizzes is displayed.	As expected.	Pass

UT-M10-TC016	The admin adds a course quiz.	Follows UT-M10-TC015. 1. Click the add icon. 2. Enter the quiz title, description, deadline, coins, and experience points rewarded. 3. Click the "Save" button.	Title: Quiz 1 Description: This is xxx. Deadline: 20/09/2025 Coins：2 Exp: 500	The course quiz is added successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC017	The admin edits a course quiz.	Follows UT-M10-TC015. 1. Click the edit icon. 2. Enter the new quiz title, description, deadline, coins, and experience points rewarded. 3. Click the "Save" button.	Title: Quiz 1 (Edited) Description: This is xxx. Deadline: 20/09/2025 Coins：2 Exp: 500	The course quiz is updated successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC018	The admin deletes a course quiz.	Follows UT-M10-TC015. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The course quiz is deleted successfully with	As expected.	Pass

				new data reflected immediately.		
UT-M10-TC019	The admin views the course quiz details.	Follows UT-M10-TC015. 1. Click the "View Details" button.	Admin account logged in.	The admin is directed to the quiz detail page.	As expected.	Pass
UT-M10-TC020	The admin adds a quiz question.	Follows UT-M10-TC019. 1. Click the add icon. 2. Enter the quiz question, options, and correct option. 3. Click the "Save" button.	Question: 1+1 Option A: 2 Option B: 3 Option C: 4 Option D: 5 Correct option: Option A	The quiz question is added successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC021	The admin edits a quiz question.	Follows UT-M10-TC020. 1. Click the edit icon. 2. Enter the new quiz question, options, and correct option. 3. Click the "Save" button.	Question: How much is 1+1? Option A: 2 Option B: 3 Option C: 4	The quiz question is updated successfully with new data reflected immediately.	As expected.	Pass

			Option D: 5 Correct option: Option A			
UT-M10-TC022	The admin deletes a quiz question.	Follows UT-M10-TC020. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The quiz question is deleted successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC023	The admin views the course assignments.	Follows UT-M10-TC005. 1. Click the "Assignment" tab.	Admin account logged in.	The list of course announcements is displayed.	As expected.	Pass
UT-M10-TC024	The admin downloads the course assignment.	Follows UT-M10-TC023. 1. Click the "Download" button.	Downloaded assignment: Assignment1.pdf	The course assignment has been successfully downloaded to the device.	As expected.	Pass

UT-M10-TC025	The admin adds a course assignment.	Follows UT-M10-TC023. 1. Enter the assignment title, description, deadline, coins, and experience points rewarded. 2. Upload a valid file. 3. Click the "Save" button.	Title: Assignment 1 Description: This is xxx. Deadline: 20/09/2025 Coins: 2 EXP: 500 File: Assignment1.pdf	The course assignment is added successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC026	The admin edits a course assignment.	Follows UT-M10-TC023. 1. Enter the new assignment title, description, deadline, coins, and experience points rewarded. 2. Upload a new valid file. 3. Click the "Save" button.	Title: Assignment 1 (Latest) Description: This is xxx. Deadline: 20/10/2025 Coins: 2	The course assignment is updated successfully with new data reflected immediately.	As expected.	Pass

			EXP: 500 File: Assignment1.pdf			
UT-M10-TC027	The admin deletes a course assignment.	Follows UT-M10-TC023. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	The course assignment is deleted successfully with new data reflected immediately.	As expected.	Pass
UT-M10-TC028	The admin views the list of course participants.	Follows UT-M10-TC005. 1. Click the "User List" tab.	Admin account logged in.	The list of course participants is displayed.	As expected.	Pass
UT-M10-TC029	The admin assigns a user to the course.	Follows UT-M10-TC028. 1. Select a user from the list. 2. Click the "Assign" button.	Shannon Tey -> English	A new user is added successfully to the course with new data reflected immediately.	As expected.	Pass

UT-M10-TC030	The admin removes a user from the course.	Follows UT-M10-TC028. 1. Click the delete icon. 2. Click the "Yes" button.	Admin account logged in.	A new user is removed successfully from the course with new data reflected immediately.	As expected.	Pass

Module: System Support						
Description: To test the support and inquiry management functionalities.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M11-TC001	The student or teacher views FAQs.	1. Log in with valid credentials. 2. Navigate to the FAQs/ Inquiries page.	User account logged in.	The list of FAQs is displayed.	As expected.	Pass
UT-M11-TC002	The student or teacher submits an inquiry ticket.	Follows UT-M11-TC001. 1. Enter email. 2. Select an inquiry type. 3. Enter description for the inquiry.	Email: shannontey29@ gmail.com	The inquiry ticket is submitted successfully.	As expected.	Pass

		4. Click the "Submit" button.	Type: Course Content Help Description: xxx			
UT-M11-TC003	The admin views a list of user inquiries.	Follows UT-M11-TC001.	Admin account logged in.	The list of user inquiries is displayed.	As expected.	Pass
UT-M11-TC004	The admin updates the user inquiry ticket.	Follows UT-M11-TC001. 1. Type in action taken. 2. Change the status. 3. Click the "Update" button.	Action taken: The action taken is xxx. Status: Pending to In-Progress	The user inquiry is updated, where the action taken is saved and reflected immediately.	As expected.	Pass
UT-M11-TC005	The admin views the audit logs.	1. Log in with valid credentials. 2. Navigate to the Audit Logs page.	Admin account logged in.	The list of audit logs is displayed.	As expected.	Pass
UT-M11-TC006	The admin filters the audit logs.	Follows UT-M11-TC006. 1. Apply filters for user type, event type, and date range. 2. Click the "Filter" button.	User type: All users Event type: Creation	The list of audit logs with filtered results is displayed.	As expected.	Pass

			From: 18/05/2025 To: 31/05/2025			

Module: Gamification Configuration						
Description: To test the gamification configuration functionalities for the admin.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M12-TC001	The admin views the gamification management page.	1. Log in with valid credentials. 2. Navigate to the Gamification Management page.	Admin account logged in.	The gamification management page is loaded successfully with all configuration options.	As expected.	Pass
UT-M12-TC002	The admin views the experience-to-level mapping.	Follows UT-M12-TC001.	Admin account logged in.	The list of experience-to-level mapping is displayed.	As expected.	Pass

UT-M12-TC003	The admin configures the level.	Follows UT-M12-TC001. 1. Navigate to the level configuration section. 2. Enter the number for the level, minimum, and maximum experience points for the level. 3. Click the "Add Level" button.	Level: 30 Min EXP: 25000 Max EXP: 30000	The level is added successfully, with the data reflected immediately in the list of experience-to-level mapping.	As expected.	Pass
UT-M12-TC004	The admin configures the leaderboard type.	Follows UT-M12-TC001. 1. Navigate to the leaderboard type configuration section. 2. Select a leaderboard type configuration. 3. Click the "Update" button.	Leaderboard Type: Coins	The leaderboard type configuration is updated successfully. It is reflected and visible on the student's leaderboard page.	As expected.	Pass
UT-M12-TC005	The admin configures the daily mission.	Follows UT-M12-TC001. 1. Navigate to the daily mission configuration section.	Type: Quiz Target Value: 2 Coins: 2	The daily mission configuration is updated	As expected.	Pass

		2. Enter the target value, coins, and experience points rewarded. 3. Click the "Update" button.	EXP: 300	successfully. It is reflected and visible on the student's leaderboard page.		
UT-M12-TC006	The admin updates the achievement badges.	Follows UT-M12-TC001. 1. Navigate to the achievement badges configuration section. 2. Click the edit icon. 3. Upload a new image. 4. Click the "Save" button.	Image uploaded: Badge1.jpg	The achievement badge is updated successfully with new data reflected immediately. It is visible on the student's achievement page.	As expected.	Pass
UT-M12-TC007	The admin updates the milestones.	Follows UT-M12-TC001. 1. Navigate to the milestones configuration section. 2. Click the edit icon. 3. Upload a new image.	Image uploaded: Milestone1.jpg	The milestone is updated successfully with new data reflected immediately. It is	As expected.	Pass

		4. Click the "Save" button.		visible on the student's achievement page.		

Module: Course Management						
Description: To test the course and content moderation functionalities for the teachers in managing all aspects of courses.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M13-TC001	The teacher views the list of courses assigned.	1. Log in with valid credentials. 2. Navigate to the My Courses page.	Teacher account logged in.	The list of all courses assigned is displayed.	As expected.	Pass
UT-M13-TC002	The teacher views the course details	Follows UT-M10-TC005.			As expected.	Pass
UT-M13-TC003	The teacher views the	Follows UT-M10-TC006.			As expected.	Pass

	course announcements.			
UT-M13-TC004	The teacher adds a course announcement.	Follows UT-M10-TC007.	As expected.	Pass
UT-M13-TC005	The teacher edits a course announcement.	Follows UT-M10-TC008.	As expected.	Pass
UT-M13-TC006	The teacher deletes a course announcement.	Follows UT-M10-TC009.	As expected.	Pass
UT-M13-TC007	The teacher views the course notes.	Follows UT-M10-TC010.	As expected.	Pass
UT-M13-TC008	The teacher downloads a course note.	Follows UT-M10-TC011.	As expected.	Pass

UT-M13-TC009	The teacher adds a course note.	Follows UT-M10-TC012.	As expected.	Pass
UT-M13-TC010	The teacher edits a course note.	Follows UT-M10-TC013.	As expected.	Pass
UT-M13-TC011	The teacher deletes a course note	Follows UT-M10-TC014.	As expected.	Pass
UT-M13-TC012	The teacher views the course quizzes.	Follows UT-M10-TC015.	As expected.	Pass
UT-M13-TC013	The teacher adds a course quiz.	Follows UT-M10-TC016.	As expected.	Pass
UT-M13-TC014	The teacher edits a course quiz.	Follows UT-M10-TC017.	As expected.	Pass

UT-M13-TC015	The teacher deletes a course quiz.	Follows UT-M10-TC018.	As expected.	Pass
UT-M13-TC016	The teacher views the course quiz details.	Follows UT-M10-TC019.	As expected.	Pass
UT-M13-TC017	The teacher adds a quiz question.	Follows UT-M10-TC020.	As expected.	Pass
UT-M13-TC018	The teacher edits a quiz question.	Follows UT-M10-TC021.	As expected.	Pass
UT-M13-TC019	The teacher deletes a quiz question.	Follows UT-M10-TC022.	As expected.	Pass
UT-M13-TC020	The teacher views the	Follows UT-M10-TC023.	As expected.	Pass

	course assignments.			
UT-M13-TC021	The teacher downloads the course assignment.	Follows UT-M10-TC024.	As expected.	Pass
UT-M13-TC022	The teacher adds a course assignment.	Follows UT-M10-TC025.	As expected.	Pass
UT-M13-TC023	The teacher edits a course assignment.	Follows UT-M10-TC026.	As expected.	Pass
UT-M13-TC024	The teacher deletes a course assignment.	Follows UT-M10-TC027.	As expected.	Pass

Module: Teacher-Student Interaction and Engagement						
Description: To test the teacher-student interaction and engagement functionalities by verifying that admins and teachers can view student lists to monitor progress, provide feedback from time to time, and participate in course forums.						
Created and Executed By: Tey Yu Jing						
Test Case	Test Title	Test Steps	Test Data	Expected Result	Actual Result	Status
UT-M14-TC001	The admin or teacher views a list of students in the course.	Follows UT-M5-TC004. 1. Click the "Student Progress" tab.	Admin or teacher account logged in.	The list of students in the course is displayed.	As expected.	Pass
UT-M14-TC002	The admin or teacher views a student's progress.	Follows UT-M14-TC001. 1. Click the eye icon.	Admin or teacher account logged in.	The submission histories of the student are displayed.	As expected.	Pass
UT-M14-TC003	The admin or teacher downloads the student's	Follows UT-M14-TC002. 1. Click the "Download Submission" button.	Downloaded assignment: Shannon_A1.pdf	The student's submission is downloaded to the device.	As expected.	Pass

	assignment submission.					
UT-M14-TC004	The admin or teacher reviews the student's quiz results.	Follows UT-M14-TC002. 1. Click the "Review Quiz Result" button.	Admin or teacher account logged in.	The student's quiz attempt is displayed.	As expected.	Pass
UT-M14-TC005	The admin or teacher provides feedback for the student's submission.	Follows UT-M14-TC002. 1. Click the "Provide Feedback" button. 2. Type in a message. 3. Upload a valid marked file if any. 4. Click the "Save" button.	Feedback: Good job.	The feedback is submitted successfully with new data reflected immediately. It is also visible on the student's side.	As expected.	Pass
UT-M14-TC006	The admin or teacher views the forum posts and replies.	Follows UT-M7-TC002.	Admin or teacher account logged in.	The list of forum posts and replies is displayed.	As expected.	Pass

UT-M14-TC007	The admin or teacher posts a post.	Follows UT-M14-TC006. 1. Click the "Start a new discussion" button. 2. Type in the message. 3. Click the "Send" button.	Post: Today's class is cancelled.	The post is posted successfully with new data reflected immediately. It is visible to all students and teachers from the same course.	As expected.	Pass
UT-M14-TC008	The admin or teacher replies to a post.	Follows UT-M14-TC006. 1. Click the "Reply" button. 2. Type in the message. 3. Click the "Send" button.	Reply: Noted. Thank you.	The reply is posted successfully with new data reflected immediately. It is visible to all students and teachers from the same course.	As expected.	Pass
UT-M14-TC009	The admin or teacher edits a	Follows UT-M14-TC006. 1. Click the edit icon.	Admin or teacher account logged in.	The content of a post or reply is	As expected.	Pass

| | post or reply content. | 2. Type in the new message content.

3. Click the "Save" button. | | updated successfully with new data reflected immediately. It is visible to all students and teachers from the same course. | | |

Appendix C: API Endpoints Documentation..

Controller: Admin Controller			
API Endpoint	Method	Description	Status
/searchUsers	GET	To retrieve a list of users based on a search.	Pass
/showUser	GET	To fetch user information.	Pass
/updateUserDetails	POST	To update user information.	Pass
/deleteUser	POST	To delete the user account.	Pass
/deleteStudentCourseEnrolled	POST	To remove a student from a course enrolled.	Pass
/deleteTeacherCourseAssigned	POST	To remove a teacher from a course assigned.	Pass
/loadAllTeachers	GET	To retrieve a list of teachers.	Pass
/loadCourseTeachers	GET	To retrieve a list of teachers assigned to a specific course.	Pass
/assignTeacherToCourse	POST	To assign a teacher to a specific course.	Pass
/loadAllStudents	GET	To retrieve a list of students.	Pass
/assignStudentToCourse	POST	To assign a student to a specific course.	Pass
/filterAuditLogRecords	GET	To retrieve a list of audit log records based on filters.	Pass

/teacherVerification	GET	To retrieve a list of teachers with pending status for verification.	Pass
/updateTeacherStatus	POST	To update the teacher's status.	Pass
/showInquiryTicketList	GET	To retrieve a list of submitted support tickets.	Pass
/updateInquiryTicket	POST	To update the status of the submitted support tickets.	Pass

Controller: Announcement Controller			
API Endpoint	Method	Description	Status
/loadAnnouncementsByCourse	GET	To retrieve a list of course announcements.	Pass
/addCourseAnnouncement	POST	To add a course announcement.	Pass
/editCourseAnnouncement	POST	To update a course announcement.	Pass
/deleteCourseAnnouncement	POST	To delete a course announcement.	Pass

Controller: Assignment Controller			
API Endpoint	Method	Description	Status
/loadAssignmentsByCourse	GET	To retrieve a list of course assignments.	Pass
/addCourseAssignment	POST	To add a course assignment.	Pass
/editCourseAssignment	POST	To update a course assignment.	Pass

/deleteCourseAssignment	POST	To delete a course assignment.	Pass
/submitCourseAssignment	POST	To submit a course assignment.	Pass

Controller: Calendar Controller			
API Endpoint	Method	Description	Status
/loadEvents	GET	To retrieve all events to be displayed in the calendar.	Pass
/loadEventOnDate	GET	To retrieve all events on a specific date.	Pass

Controller: Course Controller			
API Endpoint	Method	Description	Status
/loadAllCourses	GET	To retrieve a list of courses.	Pass
/addCourse	POST	To add a course.	Pass
/editCourse	POST	To update a course.	Pass
/deleteCourse	POST	To delete a course	Pass
/showCourse	GET	To retrieve the specific course details.	Pass
/loadAllCoursesInfo	GET	To retrieve a list of available courses for enrollment.	Pass
/enrollCourse	POST	To enroll in a specific course.	Pass

Controller: Dashboard Controller			
API Endpoint	Method	Description	Status

/loadAdminDashboard	GET	To retrieve the dashboard for the admin.	Pass
/loadUserInsight	GET	To provide user-related analytics within the web application.	Pass
/loadStudentStatus	GET	To provide insights into students' gamification status.	Pass
/loadCourseInsight	GET	To provide course-related analytics.	Pass
/loadTeacherVerificationStatus	GET	To display the current verification status of teachers.	Pass
/loadInquiryInsight	GET	To provide insights into user inquiries.	Pass
/loadTeacherDashboard	GET	To retrieve the dashboard for the teachers.	Pass
/loadTeacherCourseInsight	GET	To retrieve data for a specific course assigned to a specific teacher.	Pass
/loadTeacherCourseDetail/{coursed}	GET	To retrieve the specific course details.	Pass

/loadStudentDashboard	GET	To retrieve the dashboard for the students.	Pass
/loadStudentToDoList	GET	To retrieve a list of upcoming activities for a student.	Pass

Controller: Forum Controller			
API Endpoint	Method	Description	Status
/loadForumIdByCourse	GET	To retrieve the forum ID associated with a specific course.	Pass
/loadForumPostsByCourse	GET	To retrieve the list of posts for a forum.	Pass
/submitForumReply	POST	To submit a reply to an existing forum post.	Pass
/submitForumPost	POST	To submit a new post in the forum.	Pass
/editForumPostOrReply	POST	To edit an existing forum post or reply.	Pass

Controller: Game Controller			
API Endpoint	Method	Description	Status
/loadDailyMission	GET	To retrieve the list of daily missions.	Pass
/editDailyMission	POST	To update the daily mission.	Pass
/setLevel	POST	To update the game level.	Pass
/loadLeaderboardType	GET	To retrieve the leaderboard type.	Pass

/setLeaderboardType	POST	To update the leaderboard type.	Pass
/loadAchievementBadge	GET	To retrieve the list of achievement badges.	Pass
/addAchievementBadge	POST	To add an achievement badge.	Pass
/editAchievementBadge	POST	To update the achievement badge.	Pass
/loadMilestone	GET	To retrieve the list of milestones.	Pass
/editMilestone	POST	To update the milestone.	Pass
/loadLeaderboard	GET	To retrieve the list of the leaderboard.	Pass
/loadToDoList	GET	To retrieve the list of to-do items.	Pass
/addToDoList	POST	To add a to-do item.	Pass
/deleteToDoList	POST	To delete a to-do item.	Pass
/updateToDoList	POST	To update the to-do item.	Pass
/loadStudentBadge	GET	To retrieve the list of student badges.	Pass
/loadStudentMilestone	GET	To retrieve the list of student milestones.	Pass

Controller: Note Controller			
API Endpoint	Method	Description	Status
/loadNotesByCourse	GET	To retrieve a list of course notes.	Pass
/addCourseNote	POST	To add a course note.	Pass
/editCourseNote	POST	To update a course note.	Pass
/deleteCourseNote	POST	To delete a course note.	Pass

Controller: Notification Controller			
API Endpoint	Method	Description	Status
/getUserNotifications	GET	To retrieve a list of user notifications.	Pass
/markSingleAsRead	POST	To mark a single notification as read.	Pass
/markAllAsRead	GET	To mark all notifications as read.	Pass

Controller: Registered User Controller			
API Endpoint	Method	Description	Status
/admin/register	GET	To retrieve the registration form for creating a teacher account.	Pass
/admin/register	POST	To register an account for a teacher.	Pass

Controller: Student Progress Controller			
API Endpoint	Method	Description	Status
/loadAssignmentsInfo	GET	To retrieve a list of assignment information for a student.	Pass
/loadQuizzesInfo	GET	To retrieve a list of quiz information for a student.	Pass
/loadHistoryDetails	GET	To retrieve a list of submission histories by student.	Pass
/loadQuizzesHistoryDetails	GET	To retrieve a list of quiz details attempted by the student.	Pass

/addAssignmentFeedback	POST	To add feedback for a submitted assignment.	Pass
/addQuizFeedback	POST	To add feedback for a submitted quiz.	Pass
/loadCourseStudents	GET	To retrieve a list of course students.	Pass
/showCourseStudentProgress	GET	To retrieve student progress details.	Pass

Study Planner Controller			
API Endpoint	Method	Description	Status
/generateStudyPlanner	POST	To generate a new study plan timetable.	Pass
/loadTimetables	GET	To retrieve the list of timetables.	Pass
/updateTimetables	POST	To update a timetable.	Pass
/loadSubjectRankings	GET	To retrieve the list of subject rankings.	Pass
/updateSubjectRankings	POST	To update a subject ranking.	Pass
/loadRevisionSessions	GET	To retrieve a list of revision sessions.	Pass
/updateRevisionSessions	POST	To update a revision session.	Pass

Controller: Quiz Controller			
API Endpoint	Method	Description	Status
/loadQuizzesByCourse	GET	To retrieve a list of course quizzes.	Pass
/addCourseQuiz	POST	To add a course quiz.	Pass
/editCourseQuiz	POST	To update a course quiz.	Pass

/deleteCourseQuiz	POST	To delete a course quiz.	Pass
/showQuiz	GET	To retrieve the specific quiz details.	Pass
/loadQuizDetails	GET	To retrieve a list of quiz details.	Pass
/addQuestion	POST	To add a quiz question.	Pass
/editQuestion	POST	To update a quiz question.	Pass
/deleteQuestion	POST	To delete a quiz question.	Pass
/submitAnswers	POST	To submit a quiz answer.	Pass

Controller: User Controller			
API Endpoint	Method	Description	Status
/getStudentHeader	GET	To retrieve the student's header gamification status.	Pass
/showUserInfo	GET	To retrieve a list of user information.	Pass
/uploadProfilePicture	POST	To upload a profile picture.	Pass
/submitDocumentForStatusVerification	POST	To submit documents for the teacher's status verification.	Pass
/resetPassword	POST	To reset the account password.	Pass

/updateUserInfo	POST	To update the account information.	Pass
/deleteUserAccount	POST	To delete the account.	Pass
/submitInquiryTicket	POST	To submit an inquiry ticket.	Pass

Appendix D: Detailed UAT Results by Each Participant.

(1) Tested by: Chloe Choo Yan Yi

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006		1. Access and view the dashboard.	Pass

	Gamification and Motivation	2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(2) Tested by: Lin Zhe Zong

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(3) Tested by: Wong Jin Wei

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(4) Tested by: Chia Kai Sheng

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(5) Tested by: Lee Shi Yun

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(6) Tested by: Lai Yu Bing

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(7) Tested by: Yong Xiu Rong

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(8) Tested by: Lim Shi Yee

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(9) Tested by: Goh Jun En

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(10) Tested by: Bonnie To Kar Yee

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(11) Tested by: Chong Wen Fang

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(12) Tested by: Tang Jun Xi

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(13) Tested by: Lim Wei Xiang

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(14) Tested by: Lee Yi Zheng

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(15) Tested by: Lim Zi Qi

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(16) Tested by: Kam Yun Chin

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass

UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass
UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass

		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(17) Tested by: Chia Zi Li

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-001	Profile and Account Management	1. Register a new account.	Pass
		2. Log in with valid credentials.	Pass
		3. Update account information.	Pass
		4. Log out.	Pass
UAT-002	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-003	Notifications	1. Access and view notifications in real time.	Pass
UAT-004	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-005	Course Management, Assessment, and Performance Tracking	1. Access and view the dashboard.	Pass
		2. Enroll in a new course.	Pass
		3. Access and view the enrolled course.	Pass
		4. View and download course notes.	Pass
		5. View and submit course quizzes.	Pass
		6. View, download, and submit course assignments.	Pass
		7. View course history.	Pass

UAT-006	Gamification and Motivation	1. Access and view the dashboard.	Pass
		2. Gain rewards.	Pass
		3. Access and view the leaderboard.	Pass
		4. Access and view the daily missions.	Pass
		5. Access and view the achievement badges and milestones.	Pass
UAT-007	Communication and Interaction	1. Access and view the dashboard.	Pass
		2. Access and view forum posts.	Pass
		3. Submit a post or reply in the forum.	Pass
UAT-008	AI-Powered Personalized Learning	1. Access and view the dashboard.	Pass
		2. Edit the study plan timetable.	Pass
		3. Access and view the subject ranking.	Pass
		4. Edit the subject ranking.	Pass
		5. Access and view the revision session.	Pass
		6. Edit the revision session.	Pass
		7. Generate a study plan timetable.	Pass
		8. Access and view the to-do list items.	Pass
		9. Add, update, and delete the to-do list items.	Pass

(18) Tested by: Lin Zhi Ying

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-009	Profile and Account Management	1. Log in with valid credentials.	Pass
		1. Register an account for a teacher.	Pass

		3. Log out.	Pass
UAT-010	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-011	Notifications	1. Access and view notifications in real time.	Pass
UAT-012	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-013	User Account and Role Management	1. Global search for a user.	Pass
		2. Access and view user details.	Pass
		3. Update user details.	Pass
		4. Delete user account.	Pass
		5. Manage users' course participation.	Pass
		6. Access and view the list of teachers to be verified.	Pass
		7. Update teacher's verification status.	Pass
UAT-014	Course and Content Moderation	1. Access and view the list of all courses.	Pass
		2. Add, update, and delete courses.	Pass
		3. Manage course notes.	Pass
		4. Manage course announcements.	Pass
		5. Manage course quizzes.	Pass
		6. Manage course assignments.	Pass
		7. Manage course participants.	Pass
UAT-015	System Support	1. Access and view the list of user inquiries.	Pass

Test Case (UAT ID)	Module	Test Scenario	Status
		2. Update the user inquiry ticket.	Pass
		3. Access and view the audit logs based on filters.	Pass
UAT-016	Gamification Configuration	1. Access and view the gamification management page.	Pass
		2. Configure for gamification elements.	Pass
UAT-017	Teacher-Student Interaction and Engagement	1. Access and view the list of students.	Pass
		2. Access and view students' progress.	Pass
		3. Submit feedback and return student submission.	Pass
		4. Access and view forum posts.	Pass
		5. Submit a post or reply in the forum.	Pass
		6. Edit forum content.	Pass

(19) Tested by: Tan Choon Fung

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-018	Profile and Account Management	1. Log in with valid credentials.	Pass
		2. Update account information.	Pass
		3. Submit the document for status verification.	Pass
		4. Log out.	Pass
UAT-019	Dashboard and Analytics	1. Access and view the dashboard.	Pass

UAT-020	Notifications	1. Access and view notifications in real time.	Pass
UAT-021	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-022	Course Management	1. Access and view the list of courses assigned.	Pass
		2. Manage the course notes.	Pass
		3. Manage the course announcements.	Pass
		4. Manage the course quizzes.	Pass
		5. Manage the course assignments.	Pass
UAT-023	Teacher-Student Interaction and Engagement	1. Access and view the list of students.	Pass
		2. Access and view students' progress.	Pass
		3. Submit feedback and return student submission.	Pass
		4. Access and view forum posts.	Pass
		5. Submit a post or reply in the forum.	Pass
		6. Edit forum content.	Pass

(20) Tested by: Wo Wai Meng

Test Case (UAT ID)	Module	Test Scenario	Status
UAT-018	Profile and Account Management	1. Log in with valid credentials.	Pass
		2. Update account information.	Pass

		3. Submit the document for status verification.	Pass
		4. Log out.	Pass
UAT-019	Dashboard and Analytics	1. Access and view the dashboard.	Pass
UAT-020	Notifications	1. Access and view notifications in real time.	Pass
UAT-021	Calendar and Deadline Tracking	1. Access and view the calendar.	Pass
UAT-022	Course Management	1. Access and view the list of courses assigned.	Pass
		2. Manage the course notes.	Pass
		3. Manage the course announcements.	Pass
		4. Manage the course quizzes.	Pass
		5. Manage the course assignments.	Pass
UAT-023	Teacher-Student Interaction and Engagement	1. Access and view the list of students.	Pass
		2. Access and view students' progress.	Pass
		3. Submit feedback and return student submission.	Pass
		4. Access and view forum posts.	Pass
		5. Submit a post or reply in the forum.	Pass
		6. Edit forum content.	Pass

Appendix E: Detailed Survey Results By Each Participant.

(1) Respondent by: Chloe Choo Yan Yi

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.					/

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(2) Respondent by: Lin Zhe Zong

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				

5. I found it easy to navigate within this web application without too much backtracking or re-entering information.					/
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.		/			
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.		/			

(3) Respondent by: Wong Jin Wei

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web				/	

application as part of my study routine.				
2. I found this web application was overly complex.	/			
3. I felt that the web application was easy to use.				/
4. I think I would need help from a technical person to use this web application.	/			
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/
6. I felt there was too much inconsistency in this web application.	/			
7. I think it would be easy for most people to learn how to use this web application.				/
8. I thought the overall experience using this web application was awkward.		/		

				/	
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.		/			

(4) Respondent by: Chia Kai Sheng

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.					/

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.					/
10. I needed to learn a lot of things before I could start using this web application.		/			

(5) Respondent by: Lee Shi Yun

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.		/			

3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I		/			

	could start using this web application.				

(6) Respondent by: Lai Yu Bing

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.					/
2. I found this web application was overly complex.		/			
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.	/				

					/
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(7) Respondent by: Yong Xiu Rong

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.					/
4. I think I would need help from a	/				

technical person to use this web application.					
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.		/			

(8) Respondent by: Lim Shi Yee

	Strongly Disagree	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree

	(1)				(5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.		/			
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web	/				

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
application was awkward.					
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.		/			

(9) Respondent by: Goh Jun En

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.					/
4. I think I would need help from a technical person to use this web application.		/			
5. I found it easy to navigate within this web application without too much				/	

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
backtracking or re-entering information.					
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(10) Respondent by: Bonnie To Kar Yee

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	

2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.					/
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	

10. I needed to learn a lot of things before I could start using this web application.	/			

(11) Respondent by: Chong Wen Fang

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.		/			
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency		/			

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
in this web application.					
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(12) Respondent by: Tang Jun Xi

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	

4. I think I would need help from a technical person to use this web application.	/			
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/
6. I felt there was too much inconsistency in this web application.	/			
7. I think it would be easy for most people to learn how to use this web application.				/
8. I thought the overall experience using this web application was awkward.	/			
9. I felt confident while using the web application.			/	
10. I needed to learn a lot of things before I could start using this web application.	/			

(13) Respondent by: Lim Wei Xiang

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.					/
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.				/	

8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(14) Respondent by: Lee Yi Zheng

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.		/			
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.					/
10. I needed to learn a lot of things before I could start using this web application.		/			

(15) Respondent by: Lim Zi Qi

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web				/	

application as part of my study routine.				
2. I found this web application was overly complex.	/			
3. I felt that the web application was easy to use.				/
4. I think I would need help from a technical person to use this web application.	/			
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.			/	
6. I felt there was too much inconsistency in this web application.	/			
7. I think it would be easy for most people to learn how to use this web application.				/
8. I thought the overall experience using this web application was awkward.	/			

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(16) Respondent by: Kam Yun Chin

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.		/			
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	

6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.		/			
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(17) Respondent by: Chia Zhi Li

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				

3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I		/			

could start using this web application.				

(18) Respondent by: Lin Zhi Ying

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.		/			
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.				/	
6. I felt there was too much inconsistency in this web application.		/			

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
7. I think it would be easy for most people to learn how to use this web application.				/	
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.				/	
10. I needed to learn a lot of things before I could start using this web application.	/				

(19) Respondent by: Tan Choon Fung

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a	/				

technical person to use this web application.					
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.			/		
6. I felt there was too much inconsistency in this web application.		/			
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web application was awkward.	/				
9. I felt confident while using the web application.					/
10. I needed to learn a lot of things before I could start using this web application.		/			

(20) Respondent by: Wo Wai Meng

	Strongly Disagree	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree

	(1)				(5)
1. I think that I would like to use this web application as part of my study routine.				/	
2. I found this web application was overly complex.	/				
3. I felt that the web application was easy to use.				/	
4. I think I would need help from a technical person to use this web application.	/				
5. I found it easy to navigate within this web application without too much backtracking or re-entering information.			/		
6. I felt there was too much inconsistency in this web application.	/				
7. I think it would be easy for most people to learn how to use this web application.					/
8. I thought the overall experience using this web		/			

application was awkward.					
9. I felt confident while using the web application.					/
10. I needed to learn a lot of things before I could start using this web application.	/				